Macintosh Displays
and Video Cards

Service Guide

September 1996

Apple Computer, Inc.

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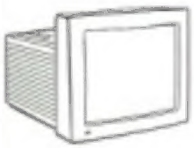
8 
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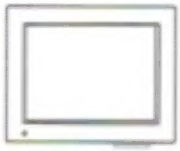
17 
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Introduction

The *Apple Service Guide for Macintosh Displays and Video Cards* is designed to assist Apple-certified technicians in troubleshooting and repairing Apple monitors at the customer's site. This guide contains monitor and video card information from the 1992 *Apple Service Guide Monitors and Mass Storage* and contains monitors and video cards introduced from October 1992 through August 1996.

The *Apple Service Guide for Macintosh Displays and Video Cards* presents information from the *Service Source CD* and other service publications in a booklet format that is easy to use and carry. The guide includes only information that experienced technicians need to quickly and reliably service Macintosh displays at the customer's site. These guides do *not* replace the Apple *Service Source CD*.

The *Macintosh Displays and Video Cards Apple Service Guide* is divided into four tabbed sections: Apple Multiple Scan Displays, Color Displays, Monochrome Displays, and Macintosh Video Cards. The displays are arrranged by size (smallest to largest) within the tabbed sections.

The *Macintosh Displays and Video Cards Apple Service Guide* contains the following chapters :

Chapter 1: General Monitor Information
Chapter 2: Apple Multiple Scan 14 Display
Chapter 3: Apple Multiple Scan 15 Display
Chapter 4: Apple Multiple Scan 17 Display
Chapter 5: Apple Multiple Scan 1705 Display
Chapter 6: AppleVision 1710 and 1710AV Display
Chapter 7: Apple Multiple Scan 20 Display
Chapter 8: Macintosh 12" RGB Display
Chapter 9: AppleColor High-Resolution RGB Monitor
Chapter 10: Apple Basic Color Monitor
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Chapter 16: Macintosh 21" Color Display
Chapter 17: Apple High-Resolution Monochrome Monitor
Chapter 18: Macintosh 12" Monochrome Display
Chapter 19: Macintosh Portrait Display
Chapter 20: Apple Two-Page Monochrome Monitor
Chapter 21: Macintosh Video Cards

Chapter 1: General Monitor Information: This chapter contains vital information that you must understand before you service any monitor, including

- Safety and ESD information
- Diagnostics guidelines
- Environmental display distortions information
- Display model numbers
- Display resolutions and specifications

Chapters 2—20: The display chapters contain information specific to particular Apple display models. These chapters include the following:

- Exploded-view drawings of the displays
- Graphics of main circuit boards
- Alphabetical parts lists with part numbers
- Video adjustment procedures
- Foldout graphics of video adjustments
- Troubleshooting information

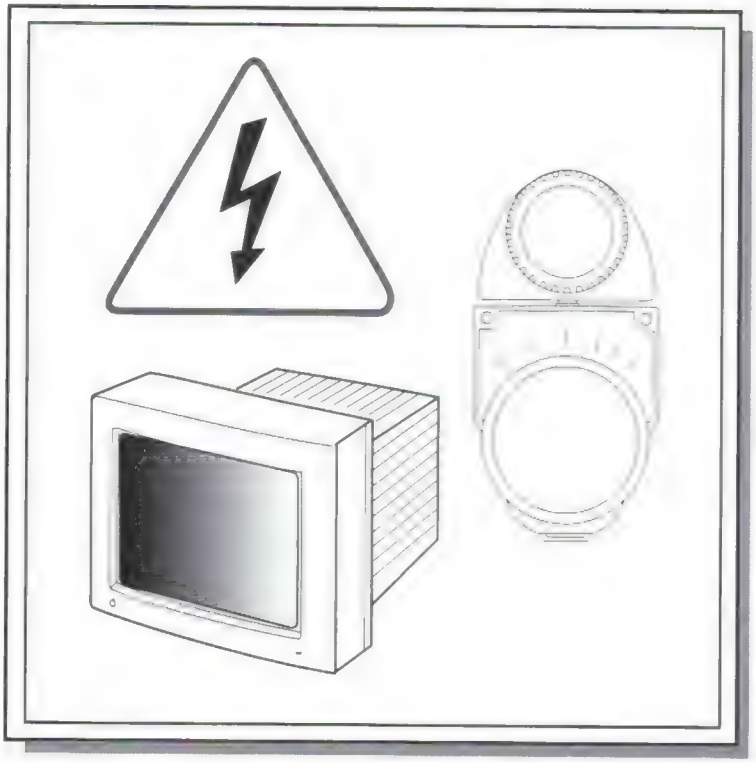
Chapter 21: Macintosh Video Cards: This chapter presents information on all Macintosh video cards, including

- Illustrated parts list
- Graphics of video cards
- Compatibility and video output charts
- Video card upgrade information

Important When ordering a replacement module or spare part, be sure to check the part number given in this guide against the current information in the AppleOrder system, or in the *Apple Service Price Pages*, which are updated frequently.

General Monitor Information

1



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Ten Rules to CRT Safety

Cathode-ray tube (CRT) monitors are dangerous. Use the following safety rules to avoid injury when working on Macintosh monitors.

1. **Do not work on a monitor alone.** In case of an accident, having someone nearby—and having someone trained in CPR—could save your life.
2. **Remove all jewelry before performing repairs on a CRT**. Removing these conductors reduces the possibility of electric shock.
3. **Never use a grounding wriststrap or heelstrap or work on a grounded workbench mat when discharging a monitor, or when performing live adjustments.**
4. **Wear safety goggles when working with a CRT.** The CRT contains a high vacuum. If cracked or broken, the CRT can implode (collapse into itself). To protect your eyes, always wear safety goggles.
5. **Before working inside a monitor, turn off the power and disconnect the external power cord.** Certain parts of a monitor chassis are hot (electrified) when the monitor is under power. Never work on a monitor under power except when making live adjustments.
6. **Keep one hand in your pocket or behind your back when working on a live monitor.** This reduces the risk of current passing through your body, should you accidentally contact high voltage.
7. **Always discharge the anode before touching anything inside the monitor** (see Figure 1). High voltage (up to 12,000 V DC) can be present on the anode and other components—even when power is off.
8. **Never touch the anode connector or the anode aperture**. When a CRT or CRT/video board is replaced, the anode connector is removed, exposing the anode. The anode can retain a charge of several thousand volts even when power is off, and can regain some charge even after discharge.
9. **Do not pick up or handle a CRT by the neck** (see Figure 1). To prevent an implosion, take every precaution against breaking the tube. Be especially careful with the neck, where the tube is thinnest.
10. **When adjusting a live CRT, never touch any of the components shown in Figure 1**.

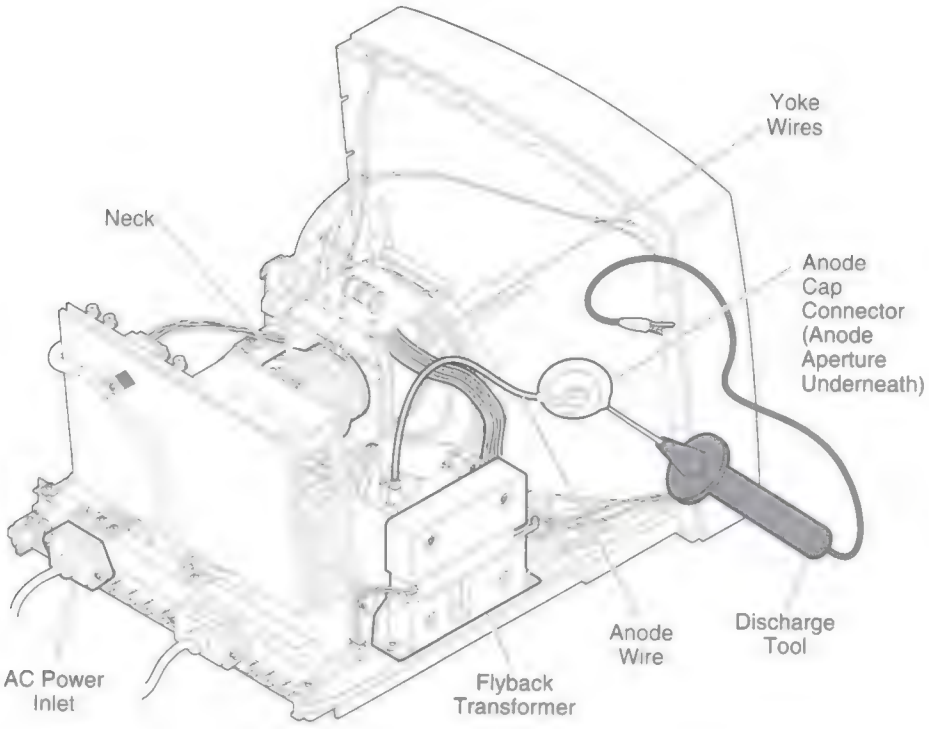


Figure 1. CRT Discharge and Danger Points

Discharging the CRT

▲ Caution **Discharge the anode to the metal part of the bezel. Failure to do so will damage the logic board.**

1. Remove your grounding wriststrap and jewelry, and put on safety goggles.
2. Attach the alligator clip on the CRT discharge tool to the metal part of the bezel (see Figure 1).
3. Put one hand in your pocket or behind your back. With your other hand, insert the tip of the CRT discharge tool under the anode cap (see Figure 1) until it touches the anode ring.
4. Remove the CRT discharge tool. To be sure that the CRT is discharged, repeat the discharge procedure. (You may want to repeat the procedure using a flat-bladed screwdriver with an insulated handle.)

▲ Warning **The anode can build up voltage over time. To drain off any residual charges, establish an ongoing ground. After discharging the CRT, fasten one end of an alligator lead to the metal part of the bezel, and the other end to the anode aperture.**

Disposing of the CRT

To prevent serious injury, follow the procedure described in this section whenever you discard a CRT.

▲ Warning **To properly dispose of a defective CRT, you must first devacuum the cathode-ray tube. Discarded CRTs that have not been devacuumed may crack and implode, injuring anyone who happens to be near.**

Materials Required

Thick cardboard box large enough to conceal the CRT
Large, sharp diagonal cutters
Large pliers and duct tape
Safety goggles and gardening gloves
12" x 12" piece of cloth or heavy paper

1. Put on safety goggles.
2. In the side of the box, cut a hole just large enough to insert the tip of the CRT neck.
3. Place the CRT inside the box with the tip of the neck protruding through the hole, and tape the box flaps down with the duct tape (see Figure 2).

▲ Warning **Only the very tip of the CRT neck should be protruding through the hole in the box, and the box must not have any other opening.**

4. Put on gloves and, using the diagonal cutters, carefully clip off the connector pins on the end of the CRT neck (see Figure 2).
5. Tape the piece of cloth or paper onto the box so that it forms a veil over the opening, but allows access to the tip of the CRT. The purpose of the veil is to catch bits of glass that may fly during the next step (see Figure 2).
6. Make sure that no one is standing nearby. Stand to one side, reach under the veil, and, with the large pliers, grasp the exposed tip of the CRT. Look away while you snip off the tip of the CRT.

You will probably hear a rush of air entering the CRT when the CRT vacuum breaks. Even if you don't, the procedure is complete if the tip of the CRT is clearly broken off.

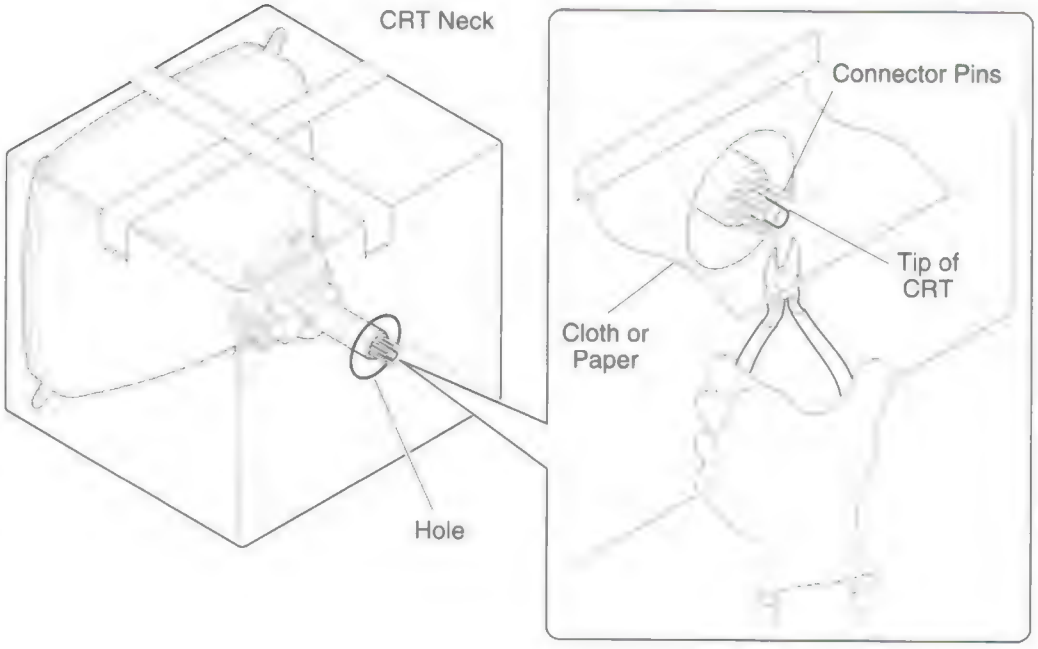


Figure 2. Devacuuming the CRT

ESD Prevention

Electrostatic discharge (ESD) can irreparably damage the sensitive chips and printed circuitry of electronic components. Plastic utensils, foam cups, polyester clothing, and even the ungrounded touch of your hand carry sufficient electrostatic charges to damage electronic components. Follow these ESD prevention rules and the procedure for setting up a safe workstation in order to prevent ESD damage.

ESD Prevention Rules

1. Before working on a device containing a printed circuit, ground yourself and your equipment. Using a grounded conductive workbench mat and a grounding wriststrap, ground your equipment to the mat.

▲ Warning

Make certain that you are *not* grounded when:

- **You work on plugged-in equipment**
- **You discharge a cathode-ray tube (CRT)**
- **You work on an unplugged CRT that has not been discharged**

2. Do not touch anyone who is working on integrated circuits (ICs). You could "zap" the equipment through the technician—even though the technician is grounded.
3. Use static-shielding bags for boards and chips during storage, transportation, and handling. Leave all Apple service components in the ESD-safe packaging until you need them.
4. Handle all ICs by the body, not the leads. Also, do not touch the edge connectors or exposed circuitry on boards or cards.
5. Do not wear polyester clothing or bring plastic, vinyl, or polystyrene plastic into the work environment. The electrostatic field around these nonconductors cannot be removed.
6. Never place components on any metal surface. Use antistatic, conductive, or special foam rubber mats.
7. If possible, keep the humidity in the service area between 70 percent and 90 percent, and use an ion generator. Charge levels are reduced (but not eliminated) in high-humidity environments and in areas with ion generators.
8. If an ESD pad/workstation is not available, plug in the computer and touch the bare metal on the power supply to discharge electrostatic charges.

Setting Up an ESD-Safe Workstation

Materials Required

- Conductive workbench mat with ground cord
- Wriststrap with built-in 1-megohm resistor and ground cord
- Equipment ground cord with alligator clips
- Ground/polarity tester

1. Remove all ESD hazards from the area. Nonconductive materials (see ESD Prevention Rule 5) cannot be grounded and can retain charges for hours (and even days).
2. Use a ground/polarity tester to verify proper grounding of the power outlet. If the outlet is wired incorrectly, most testers show a light pattern that matches a code given on the tester. If the tester does not verify proper grounding, move to another outlet that is safe.
3. Connect the ground cord. Fasten it to the workbench mat and to the wriststrap. The metal on the wriststrap should touch your skin.
4. Finally, ground the equipment on which you are working. Use alligator clips and a grounding cord to attach any metal part of the device on which you are working to the grounded workbench mat.

Environmental Display Distortions

Monitor Distortion

Environmental distortion is especially noticeable on large-screen monitors. Even monitors set to factory specifications may appear distorted when set up in a new environment. This problem affects all monitors, and is not specific to Apple monitors.

If you encounter a monitor experiencing one of the symptoms listed below, check first for environmental causes before attempting to repair or adjust the monitor.

Geometric distortion symptoms include the following:

- A jittering or shaking of the picture
- Discolored areas in the picture
- Horizontal lines cycling across the screen
- Distorted image (raster is tilted, bowed, shifted up, and so on)

These symptoms can all be caused by electromagnetic interference. Try swiveling or moving the monitor to another location, and note any changes in the display. If possible, the best test is to remove the monitor from the building, and recheck the display in an entirely different location. If the display changes when you swivel or move the monitor to another location, the environment is the source of the problem.

Environmental Influences

Possible sources of electromagnetic interference include the following:

- Other monitors
- Fluorescent lights
- Metal desks, metal file cabinets, and metal book shelves
- Motors (in fans, in air conditioners, and so on)
- Magnets (in speakers, in some mobile phones, and so on)

Keep in mind that module-swapping cannot fix a monitor with environmental distortion problems, and that adjusting a monitor with environmental distortion problems alters the factory settings. You may be able to adjust a monitor to compensate for an unfriendly environment. However, if your customer moves the monitor to another location, the resulting geometric distortion could be much worse because the monitor is no longer set to factory specifications.

Display Service Utility

This application replaces the functionality of the MacTest Pro Display Patterns and Display Settings Restore Utility. The Display Service Utility presents much of the same functionality of these former test modules, but combines them into one application that has a new, easier-to-use interface.

Use the Display Service Utility to generate video test patterns (see Figure 3), create and write display settings on multiscan displays, and to adjust the geometry of specified displays. The utility runs on any Macintosh using System 7.0 or greater, and supports all Apple displays.

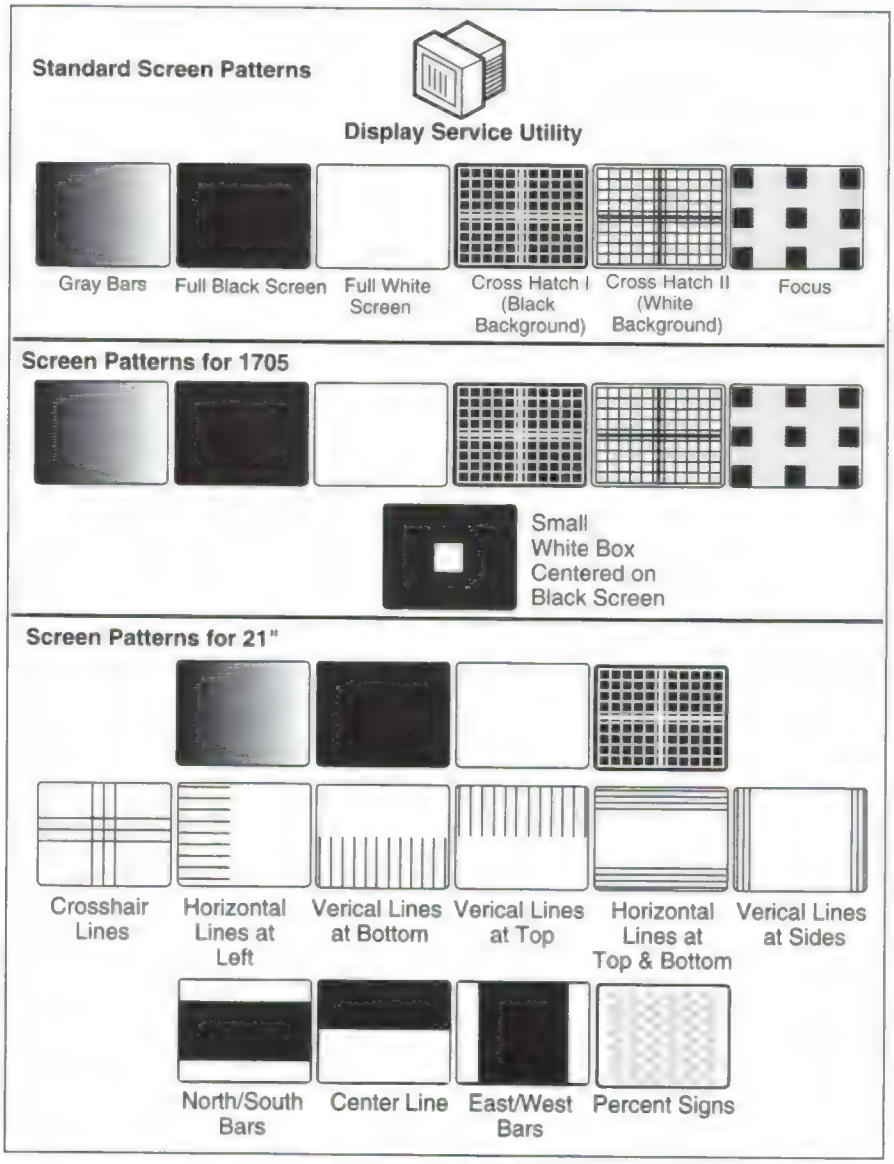


Figure 3. Display Service Utility Test Patterns

Light Meters

Luminance readings are required when adjusting monitors. The three tools to measure luminance are a photometer, the Model L-248 light meter, and the Model 246 light meter. Any of these tools can be used and the results vary with each tool.

This section covers setup for the Model L-248 and Model 246 light meters (see Figure 4), which are used for video adjustments. Readings from these meters differ. Each display has specific meter readings. Note which meter you are using before making adjustments. Refer to the "Adjustments" section in the individual chapters for meter readings.

Model L-248 Set Up

Important Because of a battery reliability issue, Apple has decided to discontinue the use of the Model L-248 light meter. The Model L-248 meter requires a battery and has proven to be inaccurate if the battery power gets low, whereas the Model 246 meter requires no battery and is consistently accurate.

To set up the Model L-248, follow these steps:

1. Check the battery. Press the red battery test button on the back of the light meter (see Figure 4A). If the reading (on the front of the meter), is out of the red area, replace the battery.
2. Move the slide switch (see Figure 4A) to the correct scale (either the 2–10 scale or the 10–18 scale).

Note Check the Adjustments section for specific monitor meter readings.

3. Slide the diffuser to uncover the lens (see Figure 4A).
4. Hold the lens against the middle of the screen. Press and release the Read button (see Figure 4A).
5. Read the scale.

Model 246 Set Up

To set up the Model 246, follow these steps:

Note Remove the metal slide, if installed, from the top of the light meter.

1. Install the white lens (see Figure 4B) with the red dot.
2. Rotate the lens and position it against the middle of the screen.
3. Read the scale (see Figure 4B). Check the Adjustments section for specific monitor meter readings.

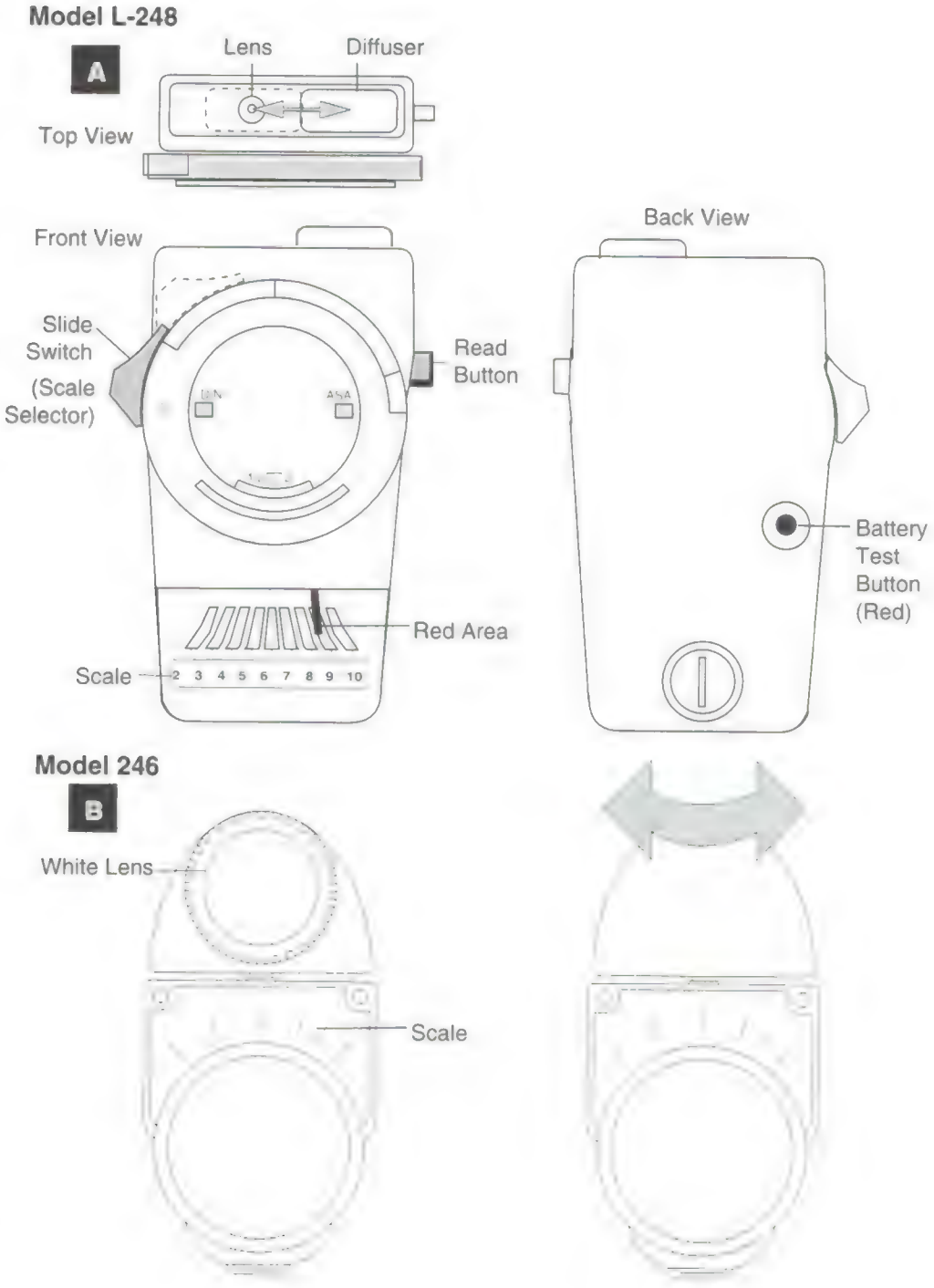


Figure 4. Light Meters

Apple Displays–Model Numbers

The table below lists model numbers that appear on the information tag at the back of Apple displays. Use Table 1 to determine what type of monitor you have.

Table 1. Apple Displays Model Numbers

Number on Monitor	Monitor Name	Note
M0400	Apple High-Resolution Monochrome Display	
M0401	AppleColor High-Resolution RGB (13" Rev A)	
M1903	Apple Basic Color Monitor (14")	Whole Unit Exchange
M9102	Apple Performa Plus Display (14")	Whole Unit Exchange
M0402	Apple Two-Page Monochrome Display (Rev A)	
M1025	Apple Two-Page Monochrome Display (Rev B)	
M0404	Macintosh Portrait Display (Rev A)	
M1030	Macintosh Portrait Display (Rev B)	
M1297	AppleColor High-Resolution RGB Display (13" Rev B)	
M1050	Macintosh Monochrome Display (12")	
M1296	Macintosh RGB Display (12")	
M1212	Macintosh Color Display	
M2001	AudioVision 14 Display	
M1298	Macintosh Color Display (16")	
M1787 or M2346	Apple Color Plus Display (14")	Whole Unit Exchange
M1823	Apple Multiple Scan 20 Display	
M3502	Macintosh Color Display (21")	
M2494	Apple Multiple Scan 17 Display	
M3935	Apple Multiple Scan 14 Display	Whole Unit Exchange
M2943	Apple Multiple Scan 15 Display	Whole Unit Exchange

Apple Displays–Dates Introduced and Discontinued

The table below lists the date of introduction and, where applicable, the date when the monitor was discontinued. Dates which are missing signify that the product is available. Refer to the Technical Information Library, article titled: "Apple Products: Dates Introduced and Discontinued," for additional information.

Table 2. Apple Displays: Dates Introduced and Discontinued

Monitor Name	Date Introduced	Date Discontinued
AppleColor High-Resolution RGB	March 1987	December 1992
AppleColor RGB	September 1986	January 1993
AppleVision 1710	January 1996	
AppleVision 1710AV	August 1995	
Apple AudioVision 14	August 1993	October 1995
Apple Basic Color	February 1993	October 1993
Apple Color Plus Display	October 1993	
Apple High-Resolution Monochrome	March 1989	February 1991
Apple Multiple Scan 14	August 1995	
Apple Multiple Scan 15	July 1994	
Apple Multiple Scan 17	March 1994	
Apple Multiple Scan 1705	January 1995	January 1996
Apple Multiple Scan 20	March 1994	
Macintosh 12-Inch Monochrome	December 1990	October 1993
Macintosh 12-Inch RGB	October 1990	March 1993
Macintosh 16-Inch Color	October 1991	April 1994
Macintosh 21-Inch Color	October 1991	March 1994
Macintosh Color 14 Display	December 1992	
Macintosh Portrait Display	March 1989	December 1992
Macintosh Two-Page Monochrome	March 1989	December 1992
Performa Display	September 1992	July 1994
Performa Plus Display	September 1992	

Monitor Resolutions and Specifications

The following table provides monitor resolutions and specifications for the Apple displays discussed in this service guide.

Table 3. Monitor Resolutions and Specifications

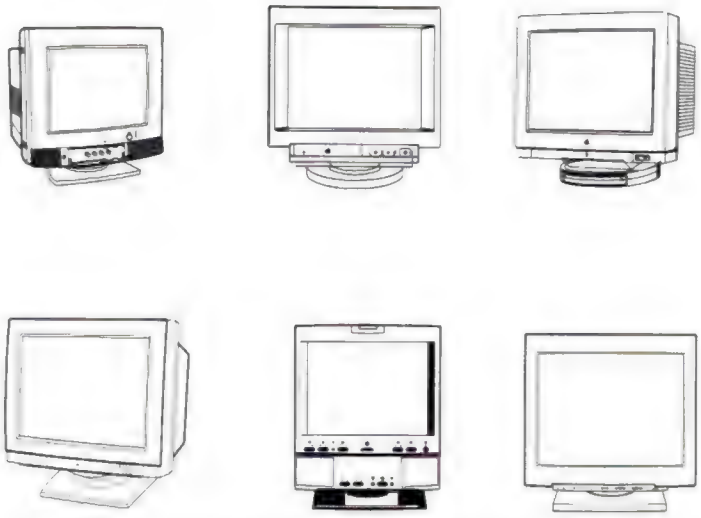
Specifications	12" Monochrome	12" RGB	Apple Basic Color Monitor	Color Plus Display	Performa	Performa Plus	13" RGB[1]	14" Color[2]	Audio-Vision 14"
Part Number	M0298LL/A	M0297LL/C	M9103LL/B	M2346LL/A	M9101LL/D	M9102LL/D	M0401LL/D	M1198LL/B	B1247LL
Resolution (pixels)	640 x 480	512 x 384	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480
Power Frequency (Hz)	50–60	47–63	50–60	47–63	57–63	57–63	47–63	50–60	50–60
Power Voltage (VAC)	90–270	100–120	100–125	90–134	98–132	98–132	100–240	100–240	100–240
Vertical Refresh	66.7 Hz	60.15 Hz	59.94 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz	66.7 Hz
Horizontal Refresh	35 kHz	24.48 kHz	31.5 kHz	35 kHz	35 kHz	35 kHz	35 kHz	35 kHz	35 kHz
Dots Per Inch (DPI)	76	64	N/A	68	67	67	69	69	69
Dot Pitch	N/A	0.28 mm	0.39 mm	0.29 mm	0.39 mm	0.28 mm	0.26 mm	0.26 mm	0.26 mm

1. All of these monitors display the same video depth at 640 x 480 resolution, so only one column is listed in the chart for all 13" monitors.
2. See footnote number 1.

Table 3. Monitor Resolutions and Specifications (Continued)

Specifications	MS 15 MS 17 MS 20 MS 14 1710AV 1710 1705 (640 x 480)	16" Color	Portrait Display	21" Mono	MS 14 MS 15 MS 17 MS 20 1710AV 1710 1705 (See Footnote #1) 832 x 624	MS 17 MS 20 1710AV 1710 1705 (See Footnote #1) 1024 x 768	21" Color	Multiple Scan 20 Display	1710AV 1710
Part Number	M3089LL M2611LL M2612LL M3935LL M3323LL M3322LL M4434LL	M1044LL/A	M0404	M0402	M3935LL/B M3089LL M2611LL M2612LL M3323LL M3322LL M4434LL	M2611LL M2612LL M3323LL M3322LL M4434LL	M5812LL/A	M2612LL/A M2612LL/B	M3323LL M3322LL
Resolution (pixels)	640 x 480	832 x 624	640 x 870	1152 x 870	832 x 624	1024 x 768	1152 x 870	1152 x 870	1280 x 1024
Power Frequency (Hz)	47–63	47–63	47–63	47–63	47–63	47–63	47–63	47–63	47–63
Power Voltage (VAC)	90-132 198-260	90–270	90–270	85–270	90–132 198–260	90–132 198–260	85–70	90–132, 198–260	90–132, 198–260
Vertical Refresh	66.7 Hz	75 Hz	75 Hz	75 Hz	75 Hz	74.93 Hz	75 Hz	75 Hz	75 Hz
Horizontal Refresh	35 kHz	50 kHz	68.9 kHz	68.7 kHz	49.73 kHz	60.24 kHz	68.7 kHz	68.7 kHz	80 kHz
Dots Per Inch (DPI)	64	70	80	77	69–79	69–79	79	79	69–79
Dot Pitch	0.26 mm	0.26 mm	N/A	N/A	0.31 mm	0.31 mm	0.26 mm	0.31 mm /A 0.26 mm /B	0.26 mm

Apple Multiple Scan Displays



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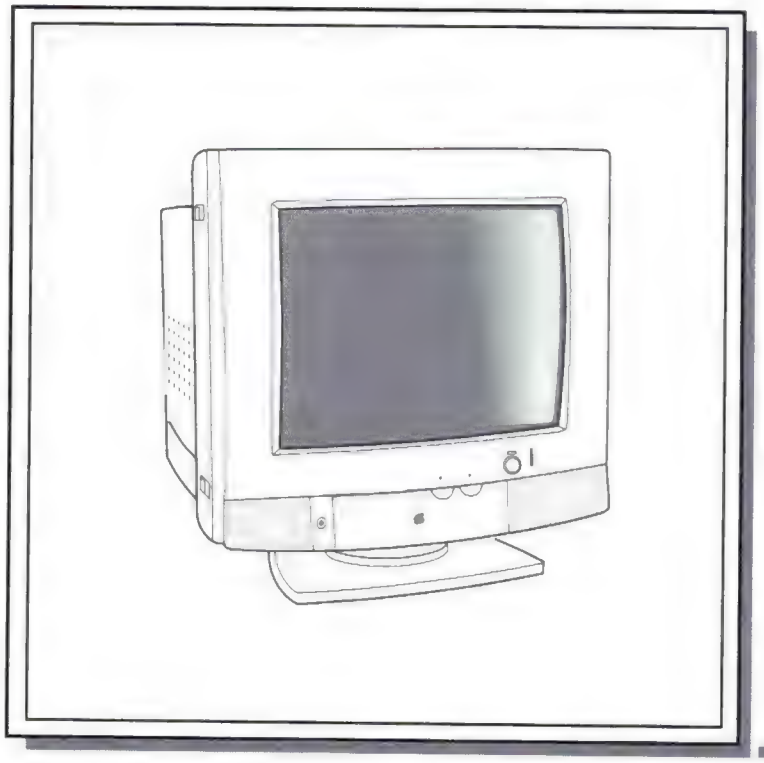
AppleVision 1710 and 1710AV Display	71
Apple Multiple Scan 20	111

Apple Multiple Scan 14 Display
(Whole Unit Exchange)

2



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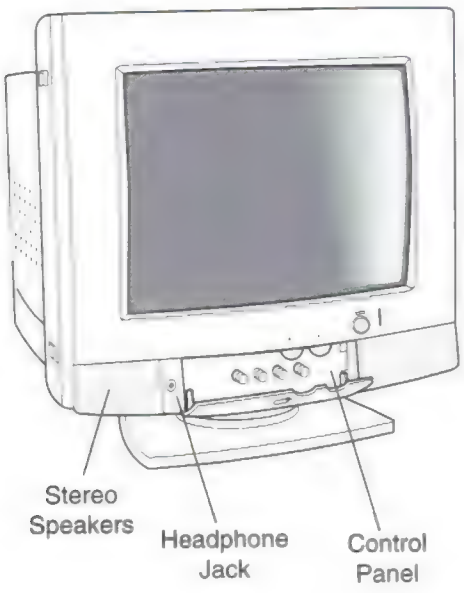
Parts List

Base, Tilt/Swivel	922-1780
Cable, Sound-Out	922-1781
Cover, User Controls	922-1786
Display, Apple Multiple Scan 14"	661-0962
Facilitation Warranty Reimbursement, Per Repair	011-0083
On-Site Warranty Reimbursement, Per Repair	011-0082
Power Cord, 110 V, Smoke	590-0380



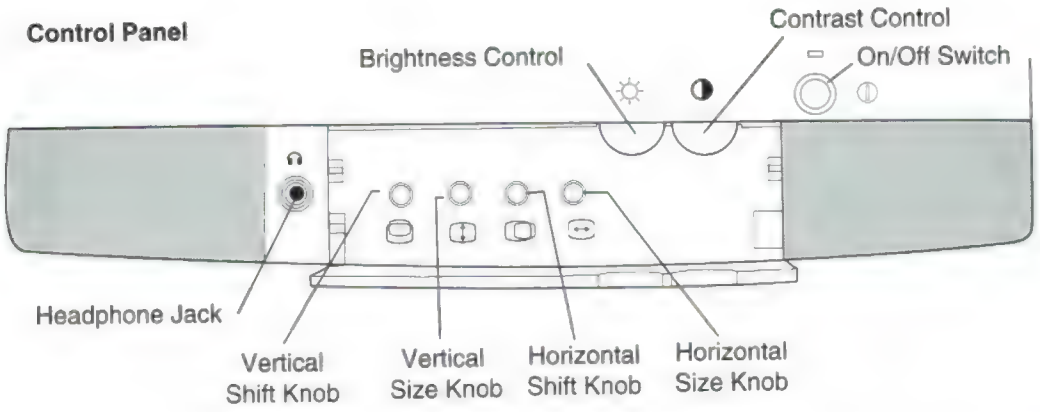


Figure 5. Apple Multiple Scan 14 Display Locator and Control Panel

Repair Issues: 832x624 Resolution

On some Apple Multiple Scan 14 displays, when the 832x624 screen resolution is selected from the Monitors control panel, the video shifts to the right and cannot be adjusted back to the center until the resolution is changed back to 640x480.

Display model M3935LL/A does not support the 832x624 screen resolution. It supports only 640x480, and on some computers, 800x600.

In November of 1995, Apple introduced an upgrade program to update qualified monitors to the Revision B display that supports the 832x624 resolution.

Determining Upgrade Eligibility

You can determine whether a display qualifies for this upgrade by the type of computer with which it is used. Refer to Table 4:

Table 4. Upgrade Eligibility for MultiScan 14

Computer	Used with Rev. A Display	Used with Rev. B Display
LC 475 Performa 475 Performa 476 Performa 6100 Power Mac 6100 Power Mac 7100 Power Mac 7200 Power Mac 7500 Power Mac 8100 Power Mac 8500 Power Mac 9500	Cannot properly center the display image. Upgrade to Rev. B.	Select 832x624 in the Monitors or Sound & Display control panel.
Mac II series LC, LC II, LC III LC 520, LC 575 LC 580, LC 5200 Mac TV Performa 400 series (except 475,476) Performa 550, 560, 575, 577, 578 Performa 5200 series All models of Power Book Power Book 200 and 2300 series (used with an Apple Duo Dock, Duo Dock II, Duo Dock Plus, or Mini-Dock)	Cannot be upgraded because the computer supports 640x480 only.	Cannot be upgraded because the computer supports 640x480 only.

For all other computers not listed in the Table 4, try the following procedure to determine if the customer's configuration would benefit from the display upgrade:

1. Open the Monitors or the Sound & Displays control panel if using System 7.5.2 or the Monitors & Sound control panel if using System 7.5.3.
2. Locate the resolution area of the control panel.

If...	Then...
Only 640x480 is shown	The computer does not support either 800x600 or 832x624 and, therefore, would not benefit from the upgrade.
Both 640x480 and 832x624 are shown	The computer can support 800x600, but the system software may or may not make 800x600 available. Go to step 3.
832x624 is shown	Go to step 3. If 800x600 cannot be accessed, upgrade to the Rev. B display.

3. Test the configuration as follows:
   a. Hold down the Option key while clicking the Options button in the Monitors control panel.
   b. If 800x600 is now available, select it and then close the Monitors control panel.
   c. Restart to activate the new screen resolution. This configuration should *not* be upgraded, since multiple screen resolutions are available.

Other computer configurations that generally should not be upgraded are the 630 series, Power Mac 6200, Quadra 660, 800, 840, 900, and 950 (check by using the procedure in Step 3).

Symptom /Cure Chart

Use the following symptom/cure chart as a troubleshooting guide. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see Chapter 1, "General Monitor Information."

For additional assistance, contact Apple Technical Support.

No Video	Solutions
No video, LED off	1. Ensure that power cord is plugged in properly. 2. Check power outlet at the wall by plugging in a known-good electronic device. 3. If display is plugged into a computer, verify that computer is on and power cord firmly connected. 4. Check video cable connection at computer and monitor. Thumbscrews must be tight. If video card is used, video cable must be properly connected to it. 5. Replace power cord. 6. Return monitor to Apple.
No video, LED on	1. Adjust brightness and contrast controls. See "Adjustments" section. 2. Check monitor cable connection, and tighten connector thumbscrews (if loose) at monitor port. 3. If monitor cable is properly connected, but power LED is yellow, verify that this monitor is supported by this computer's built-in video or video card by checking the compatibility charts in Chapter 21, "Macintosh Video Cards," or by checking the "Macintosh Monitor and Video Chart" article in the Tech. Info. Library. 4. Check that monitor is not asleep. Screen saver may be activated. Move mouse or press any key to reactivate screen. 5. Energy Saver option may be on. Move mouse or press any key on keyboard to reactivate display. Display reactivates in about 20 seconds. 6. Some Macintosh computers may not wake up after Energy Saver is activated. Restart computer and disable Energy Saver. 7. Return monitor to Apple.

Geometry	Solutions
Video image too short, tall, narrow, or wide	1. Adjust vertical and horizontal size. See "Adjustments" section. 2. Change to another screen resolution in Monitors control panel. 3. Return monitor to Apple.
Video image not centered	1. Check that distortion is not caused by environmental conditions. Move monitor to another location and rotate display. For information on environmental distortions, see Chapter 1, "General Monitor Information." 2. Adjust vertical and horizontal shift controls. See "Adjustments" section. 3. Return monitor to Apple.

Video	Solutions
Screen dark or appears dim	1. Adjust brightness. See "Adjustments" section. 2. Energy Saver option may be activated. Move mouse or press any key to reactivate monitor. 3. Return monitor to Apple.
Screen flickers	1. Check that distortion is not caused by environmental conditions. Move monitor. For information on environmental distortions, see Chapter 1, "General Monitor Information." 2. Move monitors at least 16 inches apart, if using more than one monitor on CPU. 3. Return monitor to Apple.
Black and white video only	1. Verify that color and number of colors are set correctly on Monitors control panel. 2. Return monitor to Apple.
Screen appears greenish; screen is unreadable	1. Check monitor cable connection. If a video card is present, install monitor cable into video card port. If no video card is present, install monitor cable into monitor port. 2. Return monitor to Apple.
In 832x624 screen resolution, screen is off-center, has no video, flickers, or appears distorted	1. Some models don't support 832x624 screen resolution. See the "Repair Issues" topic in the "Troubleshooting" section. 2. Select 800x600 or 640x480 screen resolution from Monitor's control panel.

Brightness and Contrast

The brightness and contrast controls (see Figure 5) are the knobs to the right of the Apple logo.

1. Move the brightness control to increase or decrease brightness.
2. Move the contrast control to increase or decrease contrast.

Geometry

The control panel is used to make horizontal and vertical adjustments. The control panel is located behind the door (see Figure 5) with the Apple logo on it.

Vertical Shift

1. Turn the vertical shift knob (see Figure 5) counterclockwise to move the center of the picture down.
2. Turn the vertical shift knob (see Figure 5) clockwise to move the center of the picture up.

Horizontal Shift

1. Turn the horizontal shift knob (see Figure 5) counterclockwise to move the center of the picture to the left.
2. Turn the horizontal shift knob (see Figure 5) clockwise to move the center of the picture to the right.

Vertical Size

1. Turn the vertical size knob (see Figure 5) counterclockwise to reduce the height of the picture.
2. Turn the vertical size knob (see Figure 5) clockwise to increase the height of the picture.

Horizontal Size

1. Turn the horizontal size knob (see Figure 5) counterclockwise to reduce the width of the picture.
2. Turn the horizontal size knob (see Figure 5) clockwise to increase the width of the picture.

Apple Multiple Scan 15 Display
(Whole Unit Exchange)

3

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Parts List

Cable, Sound Out	590-4512
Cover, User Controls	922-1136
Facilitation Warranty Reimbursement, Per Repair	011-0083
On-Site Warranty Reimbursement, Per Repair	011-0082
Power Cable, Black	922-0886
Stand, Tilt/Swivel	922-1135
Switch/Spring, Power	922-1183

Troubleshooting

Symptom/Cure Chart

Use the following symptom/cure chart as a troubleshooting guide. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see Chapter 1, "General Monitor Information."

For additional assistance, contact Apple Technical Support.

No Video	Solutions
No video, LED off	1. Check power cord connection. 2. Check power outlet at the wall by plugging in a known-working electronic device. 3. If using an AC power-strip, make sure that it is in working condition. 4. Check video cable connection at computer and monitor. Thumbscrews must be tight. If video card is used, video cable must be properly connected to it. 5. If the display is plugged into a computer, verify that the computer is on and that the power cord is firmly connected. 6. Replace power cord. 7. Return monitor to Apple.
No video, LED on	1. Adjust brightness and contrast controls. See "Adjustments" section. 2. Check monitor cable connection, and tighten connector thumbscrews (if loose) at monitor port. 3. If monitor cable is properly connected, but power LED is yellow, verify that this monitor is supported by this computer's built-in video or video card by checking the "Macintosh Monitor and Video Chart" article in the Tech. Info. Library. 4. Return monitor to Apple.

Geometry	Solutions
Video too short, tall, narrow, or wide	1. Adjust vertical and horizontal size. See "Adjustments" section. 2. Reset controls to factory settings. See "Adjustments" section. 3. Turn off Zoom feature. See "Adjustments" section. 4. Return monitor to Apple.

Video not centered	1. Check that distortion is *not* caused by environmental conditions. Move monitor. For information on environmental distortions, see Chapter 1, "General Monitor Information." 2. Adjust vertical and horizontal center controls. See "Adjustments" section. 3. Return monitor to Apple.

Video	**Solutions**
Screen dark or appears dim	1. Adjust brightness. See "Adjustments" section. 2. Energy Saver option may be activated. Move mouse or press any key to reactivate monitor. 3. Return monitor to Apple.
Screen flickers	1. Check that distortion is *not* caused by environmental conditions. Move monitor. 2. Move monitors at least 16 inches apart if using more than one monitor on computer. 3. Return monitor to Apple.
Black and white video only	1. Check to make sure that number of colors is set correctly on Monitors control panel. 2. Return monitor to Apple.

Miscellaneous	**Solutions**
Indicator light goes out before adjustments are finished	Do not pause for more than 10 seconds while adjusting controls. If you pause for 10 seconds, monitor assumes you are finished.
No sound from monitor speakers	1. Disconnect sound output cable or headphones from sound output port of computer. 2. Replace sound cable. 3. Return monitor speakers to Apple.

Brightness and Contrast

1. Turn the Brightness control (see Figure 6) to increase or decrease brightness.
2. Turn the Contrast control (see Figure 6) to increase or decrease contrast.

Geometry

Note Monitor controls are set at the factory. You can fine-tune the picture and make adjustments by using the front-panel controls. The monitor will use your settings each time it is started. Refer to "Factory Settings" in this section to recall the factory settings.

Vertical Center

1. Press and hold down the SELECT button (see Figure 6) until the vertical center indicator light goes on. Release the button.
2. Press the minus ("—") button (see Figure 6) to move the center of the picture down.
3. Press the plus ("+") button (see Figure 6) to move the center of the picture up.

Horizontal Center

1. Press and hold down the SELECT button (see Figure 6) until the horizontal center indicator light goes on. Release the button.
2. Press the minus ("—") button (see Figure 6) to move the center of the picture to the left.
3. Press the plus ("+") button (see Figure 6) to move the center of the picture to the right.

Vertical Size

1. Press and hold down the SELECT button (see Figure 6) until the height indicator light goes on. Release the button.
2. Press the minus ("—") button (see Figure 6) to reduce the height of the picture.
3. Press the plus ("+") button (see Figure 6) to increase the height of the picture.

Horizontal Size

1. Press and hold down the SELECT button (see Figure 6) until the width indicator light goes on. Release the button.
2. Press the minus ("—") button (see Figure 6) to reduce the width of the picture.
3. Press the plus ("+") button (see Figure 6) to increase the width of the picture.

Zooming

Note Zooming adjusts the picture so that it fills the entire screen. The process removes any black borders around the picture.

1. Open the front panel.
2. Press the ZOOM button (see Figure 6).
3. To return to normal size, press the ZOOM button again.

Factory Settings

Note The controls for the monitor are set at the factory. You can fine-tune the picture and make adjustments to the settings using the front panel controls. The monitor will use your settings each time the computer is turned on.

If you do not permanently overwrite the factory settings (by following the guidelines in the section, "Replacing Factory Settings" procedure), you can use the recall function to return to factory settings.

Recall

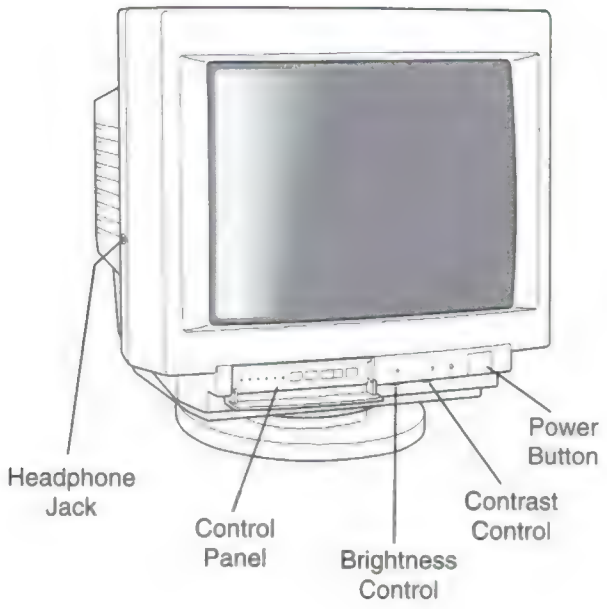
Note Turn off zooming before pressing the RECALL button.

1. Open the front panel.
2. Press the RECALL button (see Figure 6) to return to the factory settings.

Replacing Factory Settings

Note After changing the settings of the monitor, you can permanently replace the original factory settings with your own.

1. Set the controls on the monitor to the desired settings.
2. Insert a pen or straightened paperclip into the opening (see Figure 6) to the left of the zoom button. The new settings are now stored permanently in the monitor's memory.



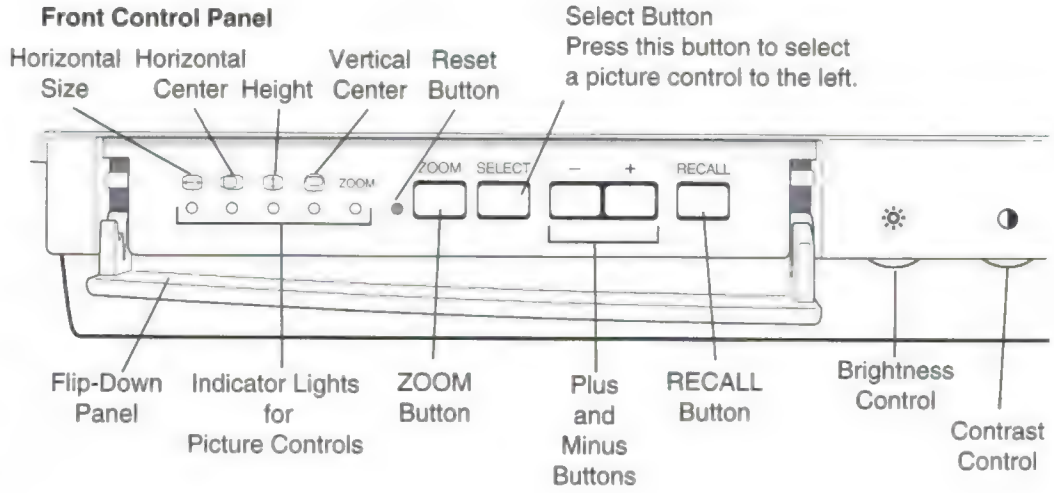


Figure 6. Multiple Scan 15 Adjustment Locators and Control Panel

Apple Multiple Scan 17 Display

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Exploded View

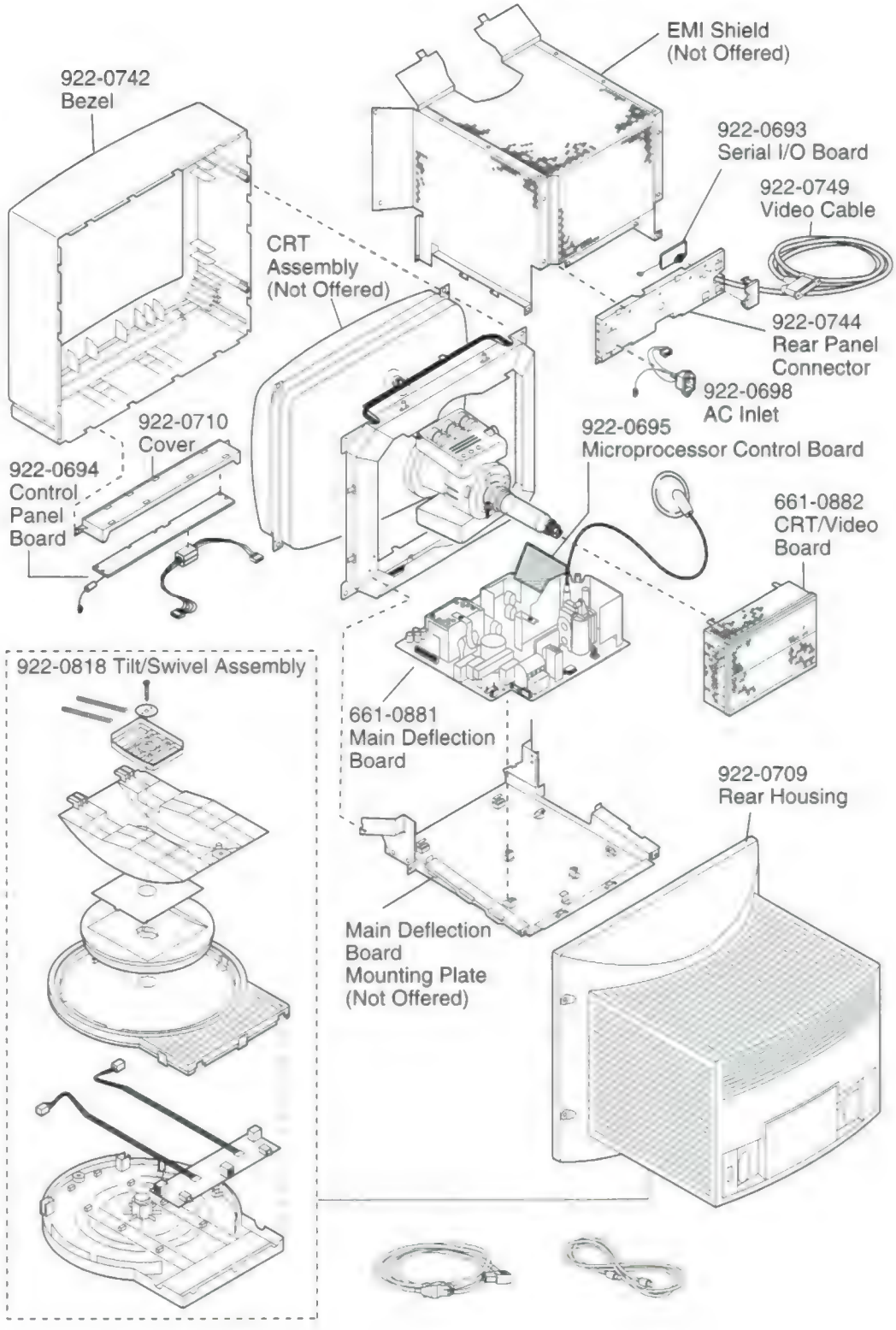

Figure 7. Multiple Scan 17 Display Exploded View

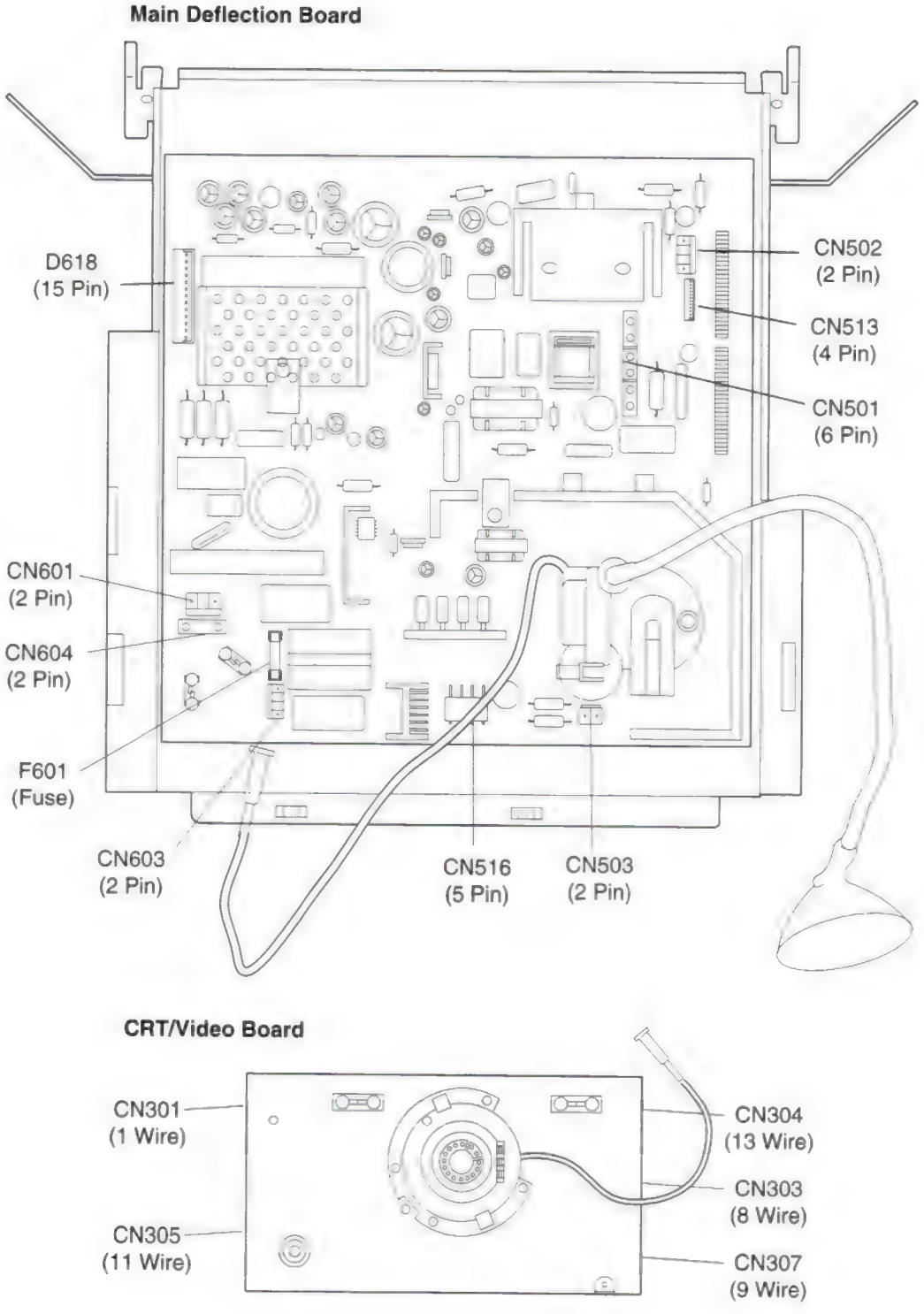

Figure 8. Multiple Scan 17 Display Main Deflection and Video Board

Parts List

AC Inlet	922-0698
Adapter, Mac/PC Display	922-0736
Bezel	922-0742
Board, Serial I/O	922-0693
Cable Assembly, Sound In	590-4513
Cable, Adapter, Multi Scan 17 to Mac II	922-1125
Cable, ADB, CPU/Tilt-Swivel Monitor Stand	590-4501
Cable, Sound Out	590-4512
Cable, Video	922-0749
Control Panel Board	922-0694
Cover, Control Panel	922-0710
CRT/Video Board	661-0882
Fuse, 4A, 250 V (Bag of 10)	922-0745
Kit, Cable	076-0230
Kit, Screw	076-0229
Label, ID	825-2745
Main Deflection Board	661-0881
Microprocessor Control Board	922-0695
Panel, Rear, Connector	922-0744
Power Cord, AC, 110 V, Smoke	590-0373
Power Cord, AC, 220 V, Smoke	590-0423
Rear Housing	922-0709
Support, Control Board	922-0743
Tilt Swivel Base	922-0818

First Checklist

Important Of the Apple Multiple Scan 17 Display modules returned for repair, 54 percent are found to be fully operational. Read this checklist before you return a module. Prevent needless module replacement and unnecessary time delays.

- **The Apple Multiple Scan 17 Display is not fully compatible with all Macintosh computers and PowerBooks**.

  If you suspect a loss of functionality, especially with the number of screen resolutions available (in Control Panels), check the Tech Info Library or contact Apple Technical Support.

- **The CRT video will not always resemble a perfect rectangle**.

  CRT tolerances allow for some distortion. Additional distortion can be caused by magnetized metal objects (desks, file cabinets, and so on). Move the unit to a different location if you notice video bowing or bent video edges.

- **Jitter, faint lines, or screen movement can be caused by external interference such as electronic devices and fluorescent lights**.

  Move the unit to another room or building to help determine if external interference is the source of the problem.

- **A misadjusted screen can mimic the symptoms of deflection board or CRT failures.**

  By performing the adjustment procedures, you might determine if one or more of the adjustments is the cause of the problem.

- **CRT's rarely fail.**

  Needless CRT replacements can be prevented by checking display adjustments, checking the possibility of other defective modules, and accepting small imperfections in screen display. If you have any doubts about whether a CRT is defective, contact Apple Technical Support.

Display Setting Restoration

Each Multiple Scan 17 monitor has an EEPROM (located on the microprocessor controller board) that contains adjustment information specific to that monitor. Before you replace the microprocessor board, save this EEPROM information.

Use Display Service Restore Utility to preserve the monitor adjustment settings.

Connect the Hardware

You can use one of two ways to connect the hardware to use the Display Service Utility:

1. Connect a serial cable (mini DIN-8) between the malfunctioning display and a separate computer running MacTest Pro. Use either the modem port or the printer port on the computer. (If you use the printer port, AppleTalk must be turned off). Also connect a power cable to the display.
   - **Advantage**: You do not have to shut down the host computer or quit MacTest Pro to complete the repair.
   - **Disadvantage**: This method requires a separate host computer (with display).
2. Connect the display as usual, using a video cable and power cable. Also, connect a serial cable (mini DIN-8) between the display and either the modem or printer port on the computer.
   - **Advantage**: This method lends itself to on-site repair. The display under repair is the only display required.
   - **Disadvantage**: Since the microprocessor board on the display must be replaced, the display may not be working well enough to view this utility. Also, after creating the data file from the old EEPROM, you must quit and shut down the computer to install the new EEPROM.

Save the EEPROM Information

To save information from the old EEPROM, create a data file:

1. Display Service Utility.
2. Choose "Apple Multiple Scan 17 & 20 from the patterns selection menu."
3. Click "Create File."

Install the Microprocessor Board

Refer to the Multiple Scan 17 Display, Take Apart chapter, on the *Service Source CD* for instructions on installing the new microprocessor board.

After the new microprocessor board is installed, the new EEPROM will have default settings that allow you to read the display, but with difficulty. When the settings from the old EEPROM are transferred to the new EEPROM, the display should be clear and the last color temperature mode chosen should be restored.

Restore the EEPROM Information

To download the saved adjustment information to the new EEPROM:

1. Display Service Utility.
2. Choose "Apple Multiple Scan 17 & 20" from the patterns selection menu.
3. Click "Create File."

▲ Caution **Make certain that you are aware of the following important information about the EEPROM data file. If data is lost or corrupted, you must return the display to Apple for repair.**

- Verify that data in the saved file is written back to the display used to create the file. Each display is unique, so writing the wrong data to a display may cause severe adjustment problems.
- Verify that the data file is deleted after writing the data back to the display. This erasure ensures that data from one display is not accidentally written to another.
- Do not delete the new data file before it's written to the new EEPROM. If the file is lost before the data can be written to the new EEPROM, the repair will be impossible to complete and the whole display must be returned.

Identifying a Defective CRT

If the monitor shuts down shortly after starting up, follow this procedure to determine if the CRT is defective:

1. Remove the monitor stand, the rear cover, discharge the CRT, and remove the EMI shield.
2. With the power off, insert a nonconductive shield (such as a strip of plastic or cardboard) between the CRT/video board and the main deflection board to shield both boards from potential shorts.

Note Twisting, bending, or applying force to the CRT/video board could damage the neck of the CRT. Be sure to pull the CRT/video board straight off the CRT.

3. Loosen the mounting screw on the neck clamp.
4. Without disconnecting any cables, pull the CRT/video board straight off the neck of the CRT (about 3/4 inch) until the board disconnects from the pins.
5. Rest the CRT/video board on the nonconductive shield.
6. Connect the monitor to a computer.
7. Plug in the power cable and turn on the monitor.
8. If the power indicator light stays on, the CRT is defective.
9. If the monitor shuts down immediately (or after a few seconds), replace the main deflection board.

Symptom/Cure Chart

Use the following symptom/cure chart as a troubleshooting guide. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see Chapter 1, "General Monitor Information."

For additional assistance, contact Apple Technical Support.

Video	Solutions
No video; power indicator light on	1. Ensure that monitor's video cable is properly connected to computer or to video card in computer. 2. Replace main deflection board.
Video image edges have color blotches when displaying an all-white screen	1. Degauss monitor with an external degaussing coil. 2. Move monitor to different location and repeat degaussing procedure. **Note**: Exchanging boards will not cure the symptom. Review "First Checklist" in this chapter before exchanging boards.
Oversized video image; menu bar might be partially cut off; adjustments have no effect on video image size	Replace main deflection board, and without disconnecting the microprocessor board, check its revision level. **Important**: On the component side of the board, look for a white mark on the upper-left corner and a 9-digit number that ends in -11, -12, or -13. If you see "-12" and a white mark, or "-13" and no white mark, you have an updated board. No board replacement required. If you see "-11" or "-12" and no white mark, replace the microprocessor board with an updated board after downloading settings as described in the section, "Display Setting Restoration," in this chapter.

Power	Solutions
No power; power indicator light off	1. Verify that power cord is properly connected to monitor and live power source. 2. Ensure that monitor's video cable is properly connected to computer or to video card in computer. 3. Replace main deflection board.

Monitor shuts down	1. Ensure that monitor's video cable is properly connected to computer or, video card in the computer. 2. Determine if CRT is the cause by following the "Identifying a Defective CRT" procedure in this chapter. 3. If CRT is not the cause, replace main deflection board. 4. Replace CRT/video board.

Indicator Lights	**Solutions**
Convergence indicator light blinks or stays on; power indicator light might also blink	After downloading settings as described in "Display Setting Restoration" in this chapter, replace microprocessor board.
Rotation indicator light blinks or stays on; power indicator light might also blink	Replace main deflection board.
Size indicator light blinks or stays on; power indicator light might also blink	1. Replace main deflection board. 2. Replace CRT/video board. 3. After downloading settings as described in "Display Setting Restoration" in this chapter, replace microprocessor board.
Centering indicator light blinks or stays on; power indicator light might also blink	1. Replace main deflection board. 2. After downloading settings as described in "Display Setting Restoration" in this chapter, replace microprocessor board.

Miscellaneous	**Solutions**
Unable to save EEPROM settings from original processor board	1. Verify cable connections 2. Verify that AppleTalk is off 3. Contact Apple Technical Support
Unable to download saved adjustment settings to new microprocessor board	1. Verify that version of Display Service Utility matches the current version in the Diagnostics folder on *Service Source CD.* 2. Contact Apple Technical Support.
Picture has vertical jitter	1. Move monitor to different location to see if symptom persists. Refer to "First Checklist" in this chapter for more information. 2. After downloading settings as described in "Display Setting Restoration" in this chapter, replace microprocessor board.

Monitor emits snapping sound; video blinks for an instant	Check to see if arcing on main deflection board is cause. If so, replace main deflection board. If not, CRT is defective. **Note:** This symptom, caused by foreign particles inside the CRT, normally occurs only in new monitors. If the symptom persists after 40 hours of operation, there is a hardware problem.

Wiring Information

Reference the following table when connecting and disconnecting video cables from the main circuit boards. Reference the callout locations in Figure 8 when removing cables from the Main Deflection Board and the CRT/Video Board.

Table 5. Multiple Scan 17 Display Wiring Information

Cables/# of Wires	Connection from:	Connection to:
6-wire (blue...brown)	Control Panel Board CN1801	Microprocessor Control Board CN907 pin 1 - brown pin 6 - blue
2-wire (brown & yellow)	Brown wire from lower part of coil adjustment; yellow wire from lower part of coil adjustment.	Main Deflection Board CN502 pin 1- brown pin 4- yellow
3-wire (black, blue, red)	Black, blue and red - all from lower part of coil adjustment	Main Deflection Board CN501 Black- GND Blue- cold Red- hot
1-wire (black)	Control Panel Board CN1802	Large metal shroud around CRT
2-wire (black & white) (black connector)	Black & white both from large black circular ring around neck of CRT	Red and white (2 wire) (white connector) red- black white- white The wires continue on to the 4 wire connector on Main Deflection Board CN513: pin 1- Red (corresponds to black on CRT ring) pin 2- White (corresponds to white on CRT ring) pin 3- (VSTAT+) - Red (goes to red wire on copper coil pin 4 - (VSTAT –) - White (goes to other red wire on copper coil)
2-wire (red & red)	Both red wires are on copper coil on the neck of the CRT.	The red wire closest to the top of the CRT goes to the red wire of pin 3 (VSTAT+) listed above. The red wire closest to the bottom of the CRT goes to the white wire of pin 4 (VSTAT–) listed above.
1-wire (red)	Main Deflection Board CN503	CRT Video Board CN301
2-prong connector	Main Deflection Board CN604	Nothing- no wires to this connector

Table 5. Multiple Scan 17 Display Wiring Information (Continued)		
Cables/# of Wires	**Connection from:**	**Connection to:**
2-wire (black)	Large portion of CRT with degausser	Main Deflection Board CN601
15-wire	Main Deflection Board CN505	CRT/Video Board CN305 pin 1- Brown pin 15- Green
5-wire (part of gray wire bundle, one wire is white)	Board with 8 pin DIN connector (Service Switch) CN1400	Microprocessor Control Board CN908 pin 1- DG pin 2- TXD pin 3- RXD pin 4- OTR pin 5- CONT
9-wire (brown...white)	CRT/Video Board CN307	Video Cable pin 1- (brown) GND pin 2- VS pin 3- CS pin 4- R.GND pin 5- Red pin 6- G.GND pin 7- Green pin 8- B.GND pin 9- (white) Blue
8-wire (part of gray wire bundle, one wire is white)	CRT/Video Board CN303	Microprocessor Control Board CN902 pin 1- black) R. Cutoff pin 2- G. Cutoff pin 3- B. Cutoff pin 4- G2 pin 5- H-Stat pin 6- V.Focus pin 7- GND pin 8 - (gray) H.Focus
13-wire (part of gray wire bundle, one wire is white)	CRT/Video Board CN304	Microprocessor Control Board CN901 pin 1- (white) DF.CHG pin 2- R.BRT pin 3- G.BRT pin 4 - B.BRT pin 5- G.DRV pin 6- B.DRV pin 7- CONT pin 8- V.SYNC pin 9- H.SYNC pin10- V.POL pin 11- H.POL pin 12- Blank pin 13- (gray) GND

Adjustments

▲ Warning **This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review the CRT safety rules in Chapter 1, "General Monitor Information."**

Brightness

1. Press the right side (up arrow) of the button (see Figure 9) to increase the brightness.
2. Press the left side (down arrow) of the button (see Figure 9) to decrease the brightness.

Contrast

1. Press the left side of the button (see Figure 9) to decrease the contrast.
2. Press the right side of the button to increase the contrast.

Geometry

The controls on this monitor require a small hex-head plastic tool to make adjustments. If the tool is long, it will be too flexible, which will make fine adjustments difficult. Use a short hex-head plastic tool to minimize flexing. Do not use metal alignment tools because they are a shock hazard.

Vertical Center

1. Press the select button (marked with "⌘") to turn on the centering indicator light (see Figure 9).
2. Press the up or down button on the brightness controls (see Figure 9) to move the center of the picture up or down.

Horizontal Center

1. Press the select button (marked with "⌘") to turn on the centering indicator light (see Figure 9).
2. Press the left or right button on the contrast controls (see Figure 9) to move the center of the picture left or right.

Vertical Size

1. Press the select button (marked with "⌘") repeatedly until the size indicator light (see Figure 9) goes on.
2. Press the up or down button on the brightness controls (see Figure 9) to increase or decrease the size of the picture.

Horizontal Size

1. Press the select button (marked with "⌘") repeatedly until the size indicator light goes on.
2. Press the left or right button on the contrast controls (see Figure 9) to decrease or increase the size of the picture.

Rotation

1. Press the select button (marked with "⌘") repeatedly until the rotation indicator light goes on (see Figure 9).
2. Press the up button on the brightness controls (see Figure 9) to tilt the picture clockwise.
3. Press the down button on the brightness controls (see Figure 9) to tilt the picture counterclockwise.

Shape

1. Press the select button (marked with "⌘") repeatedly until the rotation indicator light goes on (see Figure 9).
2. Press the left button on the contrast controls (see Figure 9) to bring in the sides of the picture.
3. Press the right button on the contrast controls (see Figure 9) to expand the sides of the picture.

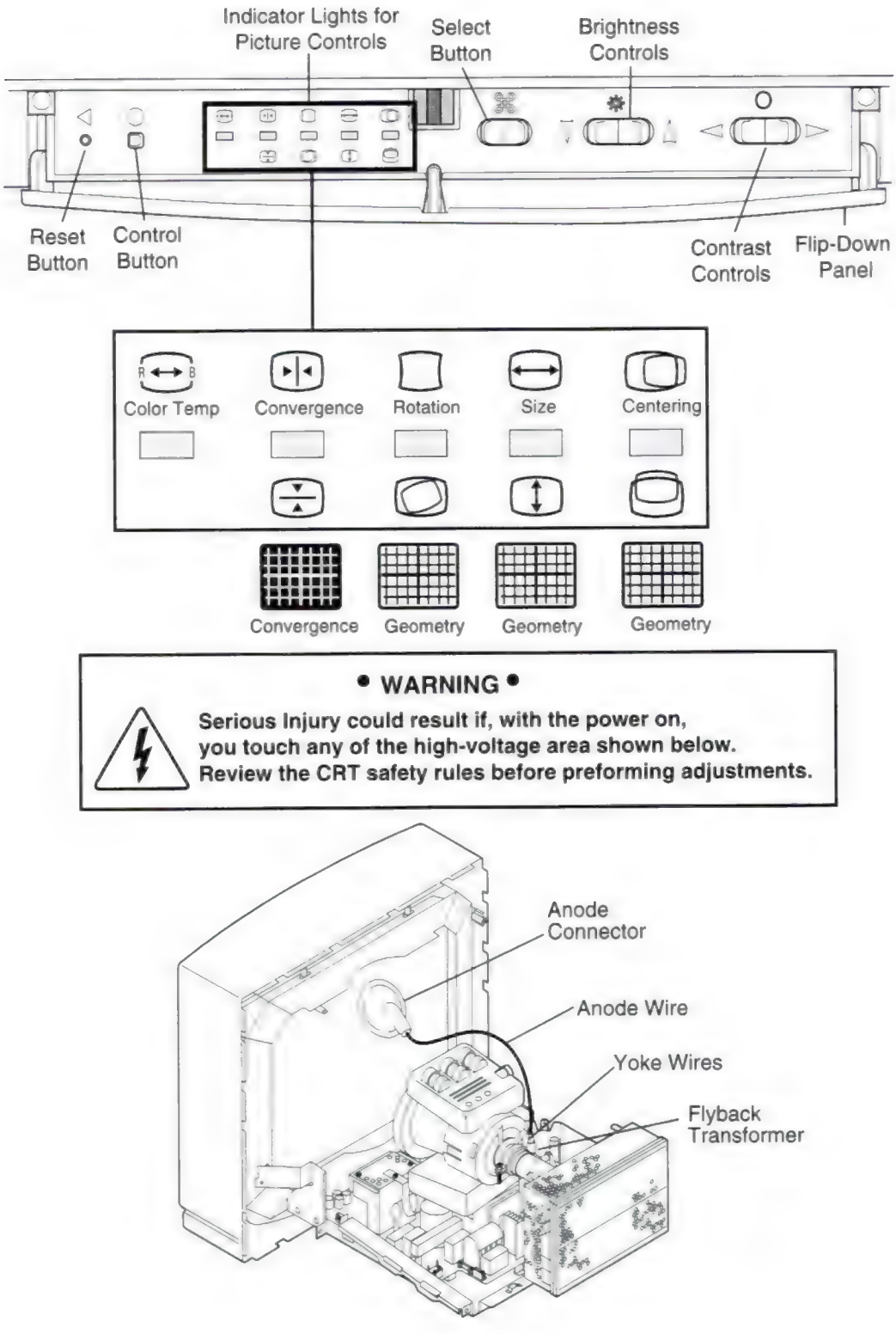

Figure 9. Apple Multiple Scan 17 Video Adjustments

Vertical Convergence

Note When the convergence is set properly, the picture is crisp and clear.

1. Press the select button (marked with "⌘") repeatedly until the convergence indicator light goes on (see Figure 9).
2. Press the up button on the brightness controls (see Figure 20) to move the red signal up and the blue signal down.
3. Press the down button on the brightness controls (see Figure 9) to move the red signal down and the blue signal up.

Horizontal Convergence

1. Press the select button (marked with "⌘") repeatedly until the convergence indicator light goes on (see Figure 9).
2. Press the left button on the contrast controls (see Figure 20) to move the red signal to the left and the blue signal to the right.
3. Press the right button on the contrast controls (see Figure 9) to move the red signal to the right and the blue signal to the left.

Color Temperature

Color temperature refers to the intensity of the red/green/blue signals sent to the monitor. The color temperature settings are

- 9300 K: white appears bluish (default)
- 6500 K: white appears page white
- 5000 K: white appears reddish

Color temperature can be changed to accommodate preference or application specifications.

1. Press the select button (marked with "⌘") repeatedly until the color temperature indicator light (see Figure 9) goes on.

Note The indicator may or may not blink, depending on the color temperature selected:

- A steady light indicates 9300 K.
- A slow-blinking light indicates 6500 K.
- A fast-blinking light indicates 5000 K.

2. Press the left button on the contrast controls (see Figure 9) to decrease the color temperature.
3. Press the right button on the contrast controls (see Figure 9) to increase the color temperature.

Factory Settings

Important The controls for the monitor are set at the factory. To fine-tune and adjust the picture, use the front panel controls. The monitor will use your settings each time the computer is turned on. Use the recall function to return to factory settings.

Recall

Note You can reset brightness and contrast to their factory levels. However, you cannot reset one or the other. You must reset both controls.

Use a straightened paper clip to push in the reset button (see Figure 9).

Reset a Specific Control

1. Press the select button (marked with an "⌘") repeatedly until the indicator light of the picture control you want to reset (vertical or horizontal center, convergence, or color temperature) goes on (see Figure 9).
2. Use a straightened paper clip to push in the Reset button (see Figure 9).
3. The selected picture control is reset to its original level.

Reset all Controls

While holding down the control button, push in the Reset button with a straightened paper clip (see Figure 9).

All picture controls are reset to their factory levels.

Apple Multiple Scan 1705 Display

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Exploded View

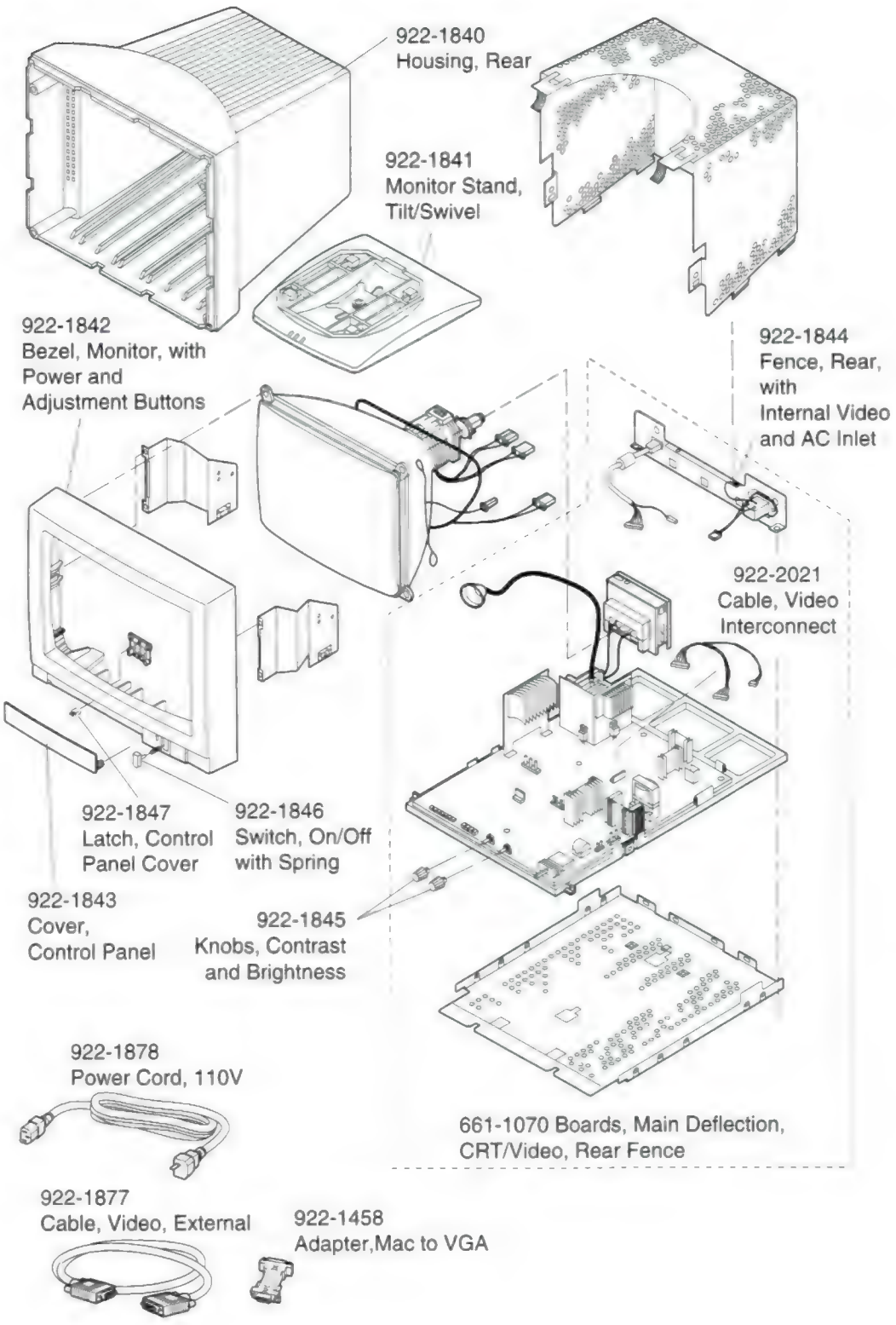


Figure 10. Apple Multiple Scan 1705 Display Exploded View

Main Circuit Boards

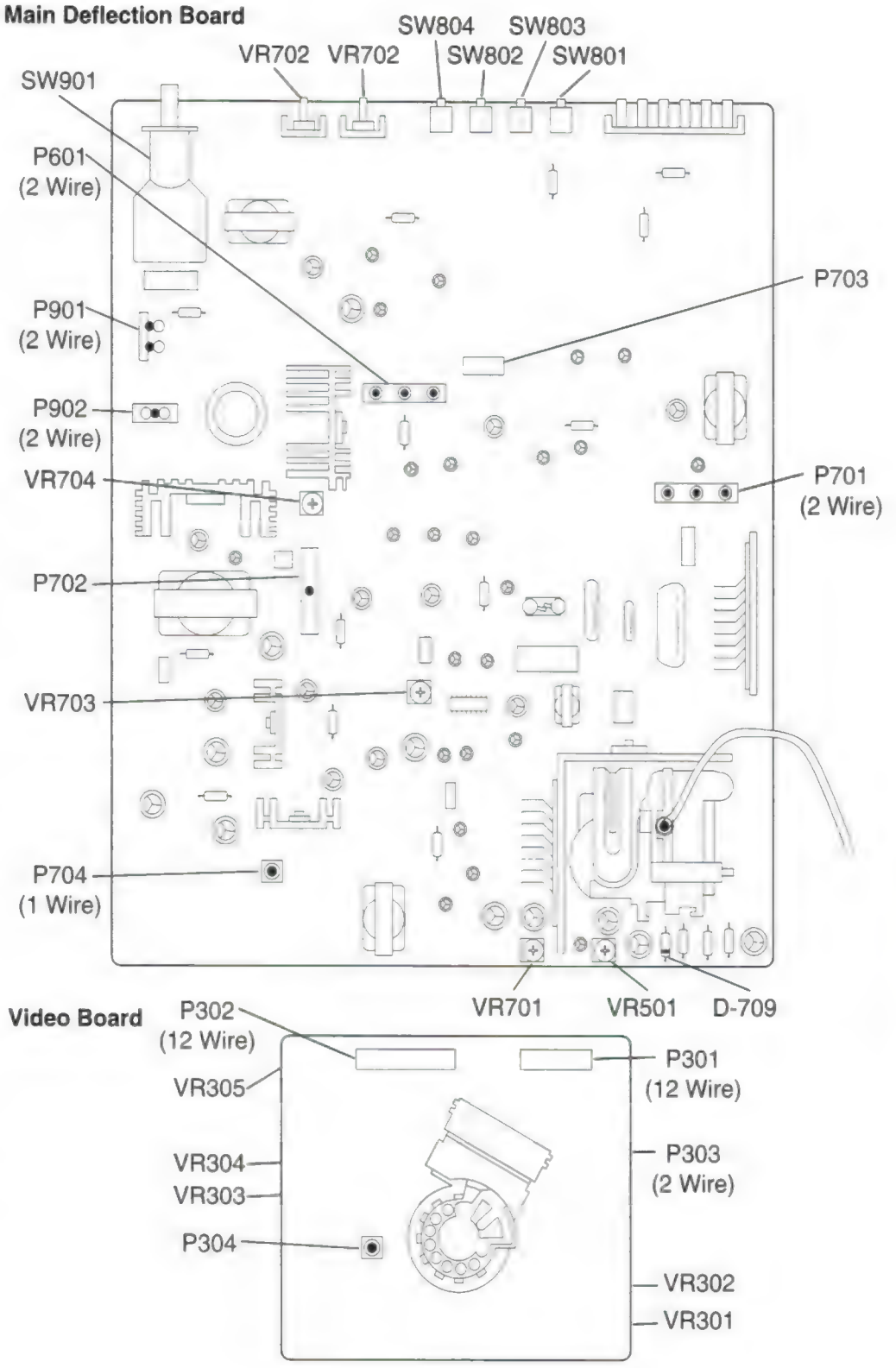


Figure 11. Apple Multiple Scan 1705 Main Deflection and Video Boards

Parts List

Adapter, Mac to VGA	922-1458
Bezel, Monitor, with Power & Adjustment Buttons	922-1842
Boards, Main Deflection, CRT/Video, Rear Fence	661-1070
Cable, Video Interconnect	922-2021
Cable, Video, External	922-1877
Cover, Control Panel	922-1843
Fence, Rear, with Internal Video and AC Inlet	922-1844
Housing, Rear	922-1840
Knobs, Contrast and Brightness	922-1845
Latch, Control Panel Cover	922-1847
Monitor Stand, Tilt-Swivel	922-1841
Power Cord, 110 V	922-1878
Switch, On/Off, with Spring	922-1846

First Checklist

Important Many Apple Multiple Scan Display modules returned for repair are found to be fully operational. Read this checklist before you return a module, and prevent needless module replacement and unnecessary time delays.

- **The Apple Multiple Scan 1705 is not compatible with all computers.**

This display works with most IBM PC-compatible computers equipped with Video Graphics Array (VGA) or greater capability. A video card may need to be installed to use this display with some computers. For more information, see the computer manual.

The display is preadjusted to work with any computer that has the following timing ranges:

- Horizontal scan rate of 31-65 Khz
- Vertical refresh rate of 47-120 Hz

For more information on what computers or video cards are compatible with the 1705 display, see the Specifications Chapter on the *Service Source CD*.

- **The video image will not always resemble a perfect rectangle.**

CRT tolerances allow for some distortion. Additional distortion can be caused by magnetized metal objects (desks, file cabinets, and so on). Move the unit to a different location if you notice video bowing or bent video edges.

- **Jitter, faint lines, or screen movement can be caused by external interference such as electronic devices and fluorescent lights.**

Move the unit to another room or building to help determine if external interference is the source of the problem.

- **A maladjusted screen can mimic the symptoms of deflection board or CRT failures.**

By performing the adjustment procedures, you might determine if one or more of the adjustments is the cause of the problem.

- **CRTs rarely fail.**

Needless CRT replacement can be prevented by checking display adjustments, checking the possibility of other defective modules, and accepting small imperfections in screen display.

Multiple Scan 1705 Repair Tips

Read the following tips before you begin troubleshooting the Multiple Scan 1705 monitor.

- The monitor stand does not need to be removed before the rear housing is removed.
- When the video and main deflection boards are removed from the bezel, special care must be taken to avoid damaging the user brightness and contrast controls. These knobs protrude about 1-inch past the main bracket and will not support the weight of the main deflection board and attached brackets.
- The video board and the main deflection board cannot be separated without risk of damaging the CRT connector. Therefore, the video board and main deflection board are considered one module and will be replaced accordingly.
- Connectors P302, P702, and P703 on the main deflection board and video board are difficult to remove. Use a small, flat-blade screwdriver to gently pry back the tabs before removing these connectors.

Special Tools

Luminance readings are required when adjusting the monitor. To do this, a color analyzer or photometer will be needed. If this equipment is not available, then a Model 246 or Model L-248 light meter can be used. Do not use other light meters. The readings given in the "Adjustments" section are based on these meters.

The Apple high-voltage probe will also be needed. Readings must be based on this probe and not on other high-voltage probes. **Do not** use other high- voltage probes.

Symptom/Cure Chart

Use the following symptom/cure chart as a troubleshooting guide. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortion, see Chapter 1, "General Monitor Information."

For additional assistance, contact Apple Technical Support.

No Video Solutions

No video with LED on	1. Check monitor cable connections. Thumbscrews must be tightened securely. If video card is used, monitor cable must be secured to card. 2. Adjust brightness and contrast controls (see Figure 12). 3. Screen saver may be activated. Move mouse or press any key to reactivate screen. 4. Energy Saver option may be on. Move mouse or press any key on keyboard to reactivate display. Display reactivates in about 20 seconds. 5. Some Macintosh computers may not wake up after Energy Saver is activated. Restart computer and disable Energy Saver. 6. See "High-Voltage" in "Adjustments" section.
No video with LED off	1. Ensure that power cord is plugged in properly. 2. Check power outlet at the wall by plugging in an electronic device that works. 3. If display is plugged into a computer, verify that computer is on and power cord firmly connected. 4. Check video cable connections at computer and monitor. Thumbscrews must be tight. If video card is used, video cable must be properly connected to it. 5. Replace video and main deflection boards. Adjust Cutoff and White Balance. See "Cutoff" and "White Balance" in "Adjustments." 6. Send monitor to Apple for repair.
No video with LED yellow	1. Check video cable connections at computer and monitor. Thumbscrews must be tight. If video card is used, video cable must be properly connected to it. 2. See "Do You Need a Video Card" in monitor user manual.

Video	Solutions
Screen flickers	1. Check monitor cable connections. The thumbscrews must be tightened securely. If video card is used, monitor cable must be secured to the card. 2. Check for external interference by moving monitor to another location. 3. If using more than one monitor with a computer, move the monitors so they are least 18 inches apart. 4. If a video card is used, check refresh rate. Refresh rates below 60 Hz may cause flicker. See video card manual to raise the refresh rate above 60 Hz. 5. Replace the video and main deflection boards. Adjust cutoff and white balance. See "Cutoff" and "White Balance" in "Adjustments."
Screen is blurred	1. Adjust Focus at VR F1 and F2. See "Focus Adjustment" in "Adjustments." 2. Replace video and main deflection boards. Adjust Cutoff and White Balance. See "Cutoff" and "White Balance" in "Adjustments."
Video is too bright	1. Adjust brightness control. See Figure 12. 2. Adjust Cutoff and White Balance. See Adjustments. 3. Replace video and main deflection boards. Adjust Cutoff and White Balance. See "Cutoff" and "White Balance" in "Adjustments."
Colors are too green, red, or blue, and the screen is unreadable	1. Ensure that the video card or computer video port is good by connecting known-good monitor. 2. Ensure that video cable is properly connected and thumbscrews are tight. If video card is used, video cable must be properly attached to it. 3. Adjust Cutoff and White Balance. See "Cutoff" and "White Balance" in "Adjustments." 4. Replace the video and main deflection boards. Adjust Cutoff and White Balance. See "Cutoff" and "White Balance" in "Adjustments."
No color	Ensure that setting for number of colors in the Monitor Control panel is correct. See the monitor user manual.

Geometry	Solutions
Video image is too short, tall, narrow, or wide	1. Adjust the width and height of the screen. See "Geometry" in "Adjustments." 2. Replace the video and main deflection boards. Adjust Cutoff and White Balance. See "Cutoff" and "White Balance" in "Adjustments."
Video image is not centered	1. Check that distortion is not caused by environmental conditions. Move the monitor. For information on environmental distortions, see Chapter 1, "General Monitor Information." 2. Adjust vertical and horizontal center of screen. See "Geometry" in "Adjustments." 3. Adjust video center at VR701. See "Video Center Adjustment" in "Adjustments." 4. Replace video and main deflection boards. Adjust Cutoff and White Balance. See "Cutoff" and "White Balance" in "Adjustments."

Miscellaneous	Solutions
Indicator light goes out before adjusting the display controls is completed.	LED will go out after 10 seconds by design. This is a normal function.

Wiring Information

Reference the following table when connecting and disconnecting video cables from the main boards. Reference callouts on Figure 11 or Figure 13 when using this wiring diagram.

Table 6. Multiple Scan 1705 Display Wiring Locator Information

Cable connector/ # of wires	Location on Main Deflection board	Other end of cable goes to:
2 wire (red, white)	P901	AC connector green/yellow – chassis ground
2 wire (brown, brown)	P902	Degauss coil
1 wire (black)	P704	Chassis ground
10-pin connector (9 wire) (8 gray, empty, blue)	P702	CRT/Video Board – P302
3-pin connector (2 wire) (brown, empty, yellow)	P601	Black yoke ring
4 wire (3 gray, gray/blue)	P703	CRT/Video Board – P302
3-pin connector (2 wire) (blue, empty, red)	P701	Black yoke ring
Internal Video Cable	External Video Port	CRT/Video Board – P302

Adjustments

Brightness

Rotate the brightness control clockwise or counterclockwise to increase or decrease brightness.

Contrast

Rotate the contrast control clockwise or counterclockwise to increase or decrease contrast.

Geometry

Horizontal Center

1. Press and hold the SELECT button until the indicator light for the horizontal center icon goes on (see Figure 12).
2. Press the DOWN and UP buttons (see Figure 12) to move the center of the picture left or right.

Horizontal Size

1. Press and hold the SELECT button until the indicator light for the width icon goes on (see Figure 12).
2. Press the DOWN and UP buttons (see Figure 12) to narrow or widen the picture.

Vertical Center

1. Press and hold the SELECT button until the indicator light for the vertical center icon goes on (see Figure 12).
2. Press the DOWN and UP buttons (see Figure 12) to move the center of the picture down or up.

Vertical Size

1. Press the SELECT button until the indicator light for the height icon goes on (see Figure 12).
2. Press the DOWN and UP buttons (see Figure 12) to decrease or increase the height of the picture.

Picture Curvature

1. Press and hold the SELECT button until the indicator light for the picture curvature icon goes on (see Figure 12).
2. Press the DOWN and UP buttons (see Figure 12) to change the arch of the picture border.

Picture Side Alignment

1. Press and hold the SELECT button until the indicator light for the side alignment icon goes on (see Figure 12).
2. Press the DOWN and UP buttons (see Figure 12) to change the alignment.

Degauss

Press the DEGAUSS button (see Figure 12) to degauss the monitor.

Factory Settings

Picture controls are generally fine-tuned by the user. To revert to the factory settings, press the DOWN and UP buttons at the same time.

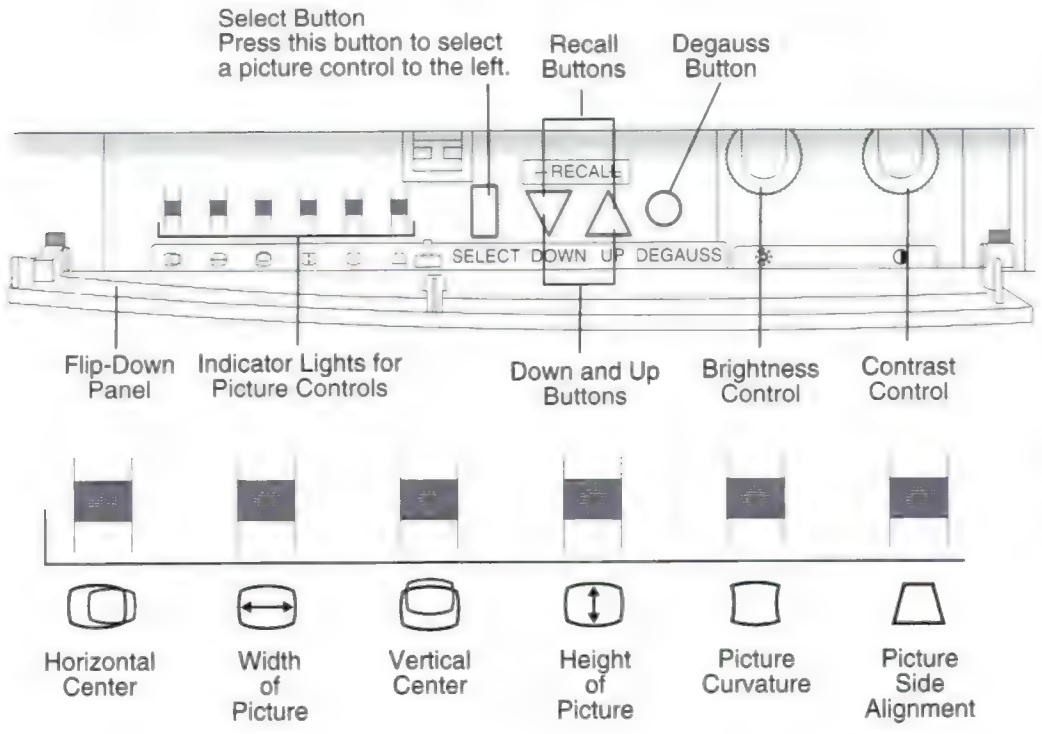


Figure 12. Apple Multiple Scan 1705 User Adjustments

Video

▲ Warning **This product contains high voltage and a high-vacuum picture tube. To prevent serious injury or equipment damage, review the CRT safety rules in Chapter 1, "General Monitor Information."**

Note Reference the "Video Adjustments Foldout," Figure 13, when performing all Video adjustments. Unfold Figure 13 so that the graphic is visible while making adjustments.

Video Center

1. Using MacTest Pro Display Service Utility, select the display pattern containing a grid on a white field.
2. Set the user controls to maximum brightness and contrast (clockwise).
3. Adjust VR701 (VIDEO CENTER) so the picture is horizontally centered on the screen (see Figure 13A).

Focus

1. Using MacTest ProUsing Display Service Utility, select the display pattern containing nine gray boxes on a dark field.
2. Set the user controls to maximum brightness and contrast (clockwise).
3. Adjust the focus at VR F1 and F2 on the flyback transformer (see Figure 13A), until the focus test pattern reaches the best possible focus at the center of the screen.

High Voltage

Note Adjust the high voltage whenever a module is replaced, or if the setting at VR501 was accidentally changed.

1. Using MacTest Pro Display Service Utility, select the display pattern containing a grid on a white field.
2. Using the height and width controls on the front control panel, adjust the screen size to 12 inches (300 mm) by 9 inches (225 mm).
3. Attach the multimete ras follows:
   - Attach the negative probe to the chassis (ground).
   - Hold the positive probe to the lead on the striped side of the D709 cathode (see Figure 13A).
4. Adjust the voltage at VR501 (see Figure 13A) until the multimeter reads 29.5 V ± 0.1 V.

Cutoff

Cutoff and White Balance adjustments must be performed whenever the video and main deflection boards are replaced. Replacement modules must be adjusted to the monitor's CRT before color and brightness can be reproduced correctly.

Before you begin,

1. Turn on the monitor, and let it warm up for a minimum of 15 minutes.
2. Degauss the CRT screen.
3. Adjust the high voltage.
4. Set the user controls to maximum brightness and contrast (clockwise).
5. Adjust VR305 (see Figure 13B) to its maximum position (clockwise).
6. Adjust VR704 (see Figure 13A) to its center position.
7. Adjust VR301 (G-DRIVE) and VR302 (R-DRIVE) to their center positions (see Figure 13B).
8. Adjust VR303 (R-BIAS) and VR304 (G-BIAS) to their minimum positions (counterclockwise) (see Figure 13B).

Note If presets were done correctly, when the white screen is displayed using Display Service Utility, the screen will have a blue tint. If the blue tint is not present, redo the presets.

9. In the Monitor control panel, set the monitor operation to a resolution of 832x624.
10. Using MacTest Pro Display Service Utility, select the all-white screen.
11. Adjust the screen control.
    - If using a Model 246 light meter,
      a. Remove the white disk lens.
      a. Hold the meter to the center of the screen.
      b. Adjust the screen control (see Figure 13A) until the meter reads between 5 and 10 on the lower scale.
    - If using an Model L-248 light meter,
      a. Set the scale to 2–10.
      b. Hold the meter to the center of the screen.
      c. Adjust the screen control (see Figure 13A) until the meter reads between 5 and10 on the lower scale.
    - If using a photometer or color analyzer, adjust the screen control (see Figure 13A) until the screen brightness is 0.3 foot lamberts.

Note VR304 and VR303 (see Figure 13B) may need to be adjusted several times to obtain a neutral gray.

12. Adjust VR304 (G-BIAS) until the screen is blue-green (equal amounts of blue and green).
13. Adjust VR303 (R-BIAS) until the screen is neutral gray (no color present).
14. Adjust VR305 (see Figure 13B).
    - If using a Model 246 light meter,
      a. Remove the white disk lens on the meter.
      b. Hold the meter to the center of the screen.
      c. Adjust sub-brightness pot VR305 (see Figure 13) until the meter reads between 15 and 20 on the lower scale.
    - If using a Model L-248 light meter, set the scale to 2–10.
      a. Hold the meter to the center of the screen.
      b. Adjust sub-brightness pot VR305 (see Figure 13) control until the meter reads between 5 and 6 on 2–10 scale.
    - If using a photometer or color analyzer, adjust sub-brightness pot VR305 until the screen brightness is 0.9 foot lamberts.

White Balance

Note Cutoff must be properly set before the white balance can be adjusted. If the Cutoff was ***not*** adjusted, go to that procedure and adjust the Cutoff now.

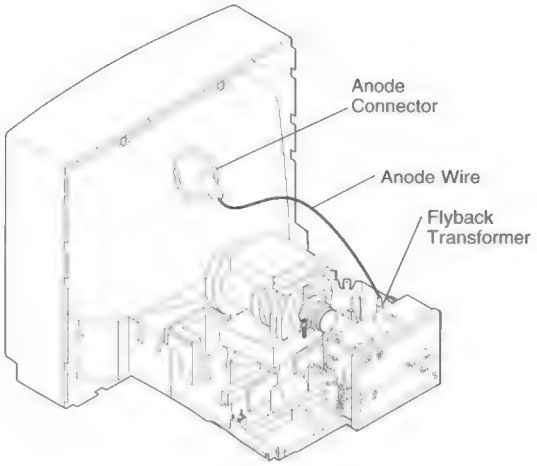
1. Using MacTest Pro Display Service Utility, select the display pattern containing a small white box on a black field.
2. Adjust sub-contrast pot VR704 (see Figure 13A).
    - If using a Model 246 light meter,
      a. Replace the white disk lens on the meter.
      b. Hold the meter to the center of the screen.
      c. Adjust sub-contrast pot VR704 (see Figure 13A) until the meter reads between 26 and 27 on the lower scale.
    - If using a Model L- 248 light meter,
      a. Set scale to 10–18.
      b. Hold the meter to the center of the screen.
      c. Adjust sub-contrast pot VR704 (see Figure 13A) until the meter reads 11 on the 10–18 scale.

- If using a color analyzer or photometer, adjust sub-contrast pot VR704 (see Figure 13A) until screen brightness is 50 foot lamberts.

3. Using MacTest Pro Display Service Utility, select the all-white display pattern.
4. Adjust VR703 (ABL)
   - If using a Model 246 light meter,
     a. Ensure that the white disk lens is installed on the meter.
     b. Hold the meter to the center of the screen.
     c. Adjust VR703 (ABL) until the meter reads between 16 and 17 on the lower scale (see Figure 13A).
   - If using a Model L-248 light meter,
     a. Set the scale to 2–10.
     b. Hold the meter to the center of the screen.
     c. Adjust VR703 (ABL) until the meter reads 9.5 on the 2–10 scale.
   - If using a color analyzer or photometer, adjust VR703 (ABL) until the brightness on the screen is 24 foot lamberts.
5. Set the user brightness control to the middle position.

Safety • WARNING •

Serious Injury could result if, with the power on, you touch any of the high-voltage area shown below. Review the CRT safety rules before preforming adjustments.



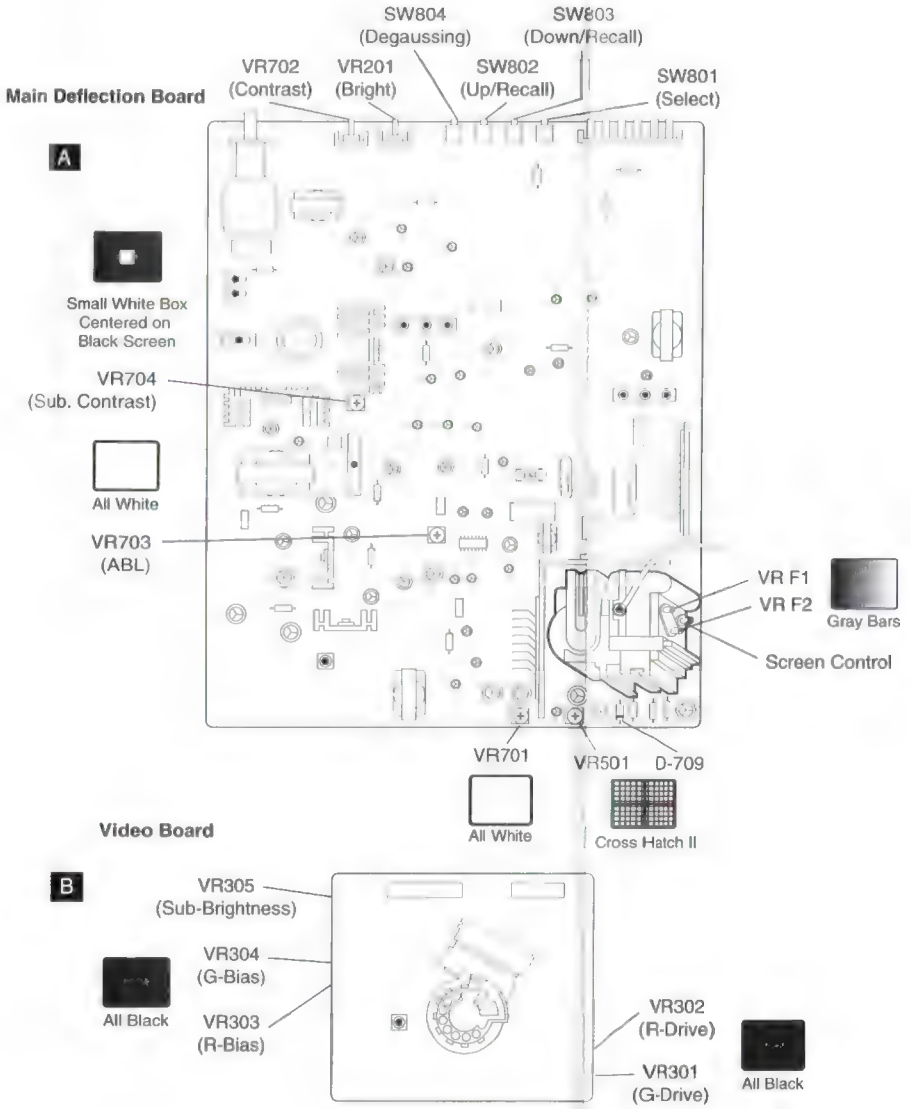


Figure 13. Apple Multiple Scan 1705 Display Adjustments

AppleVision 1710 and 1710AV Display

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Exploded View

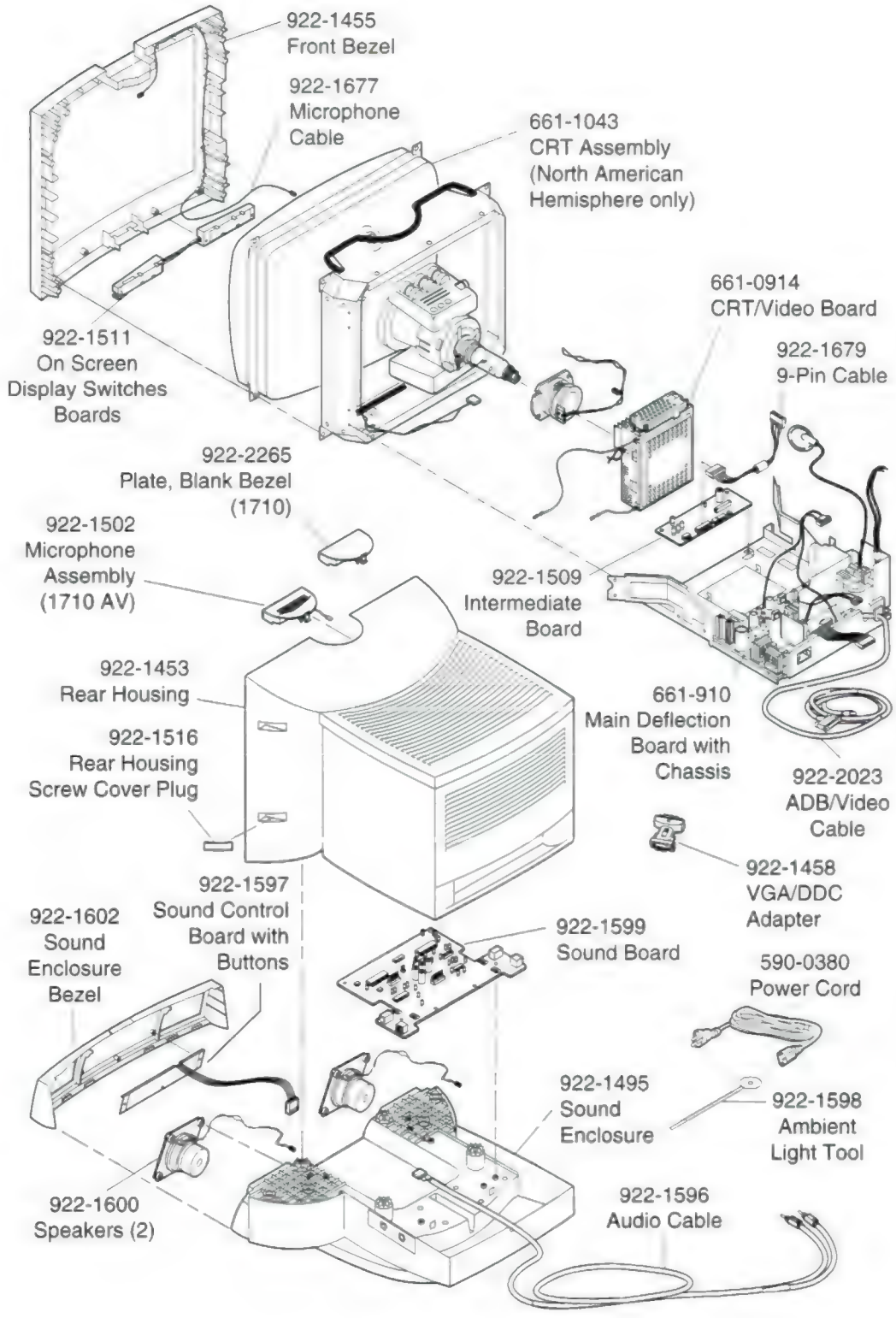


Figure 14. AppleVision 1710 and 1710 AV Exploded View

Main Circuit Boards

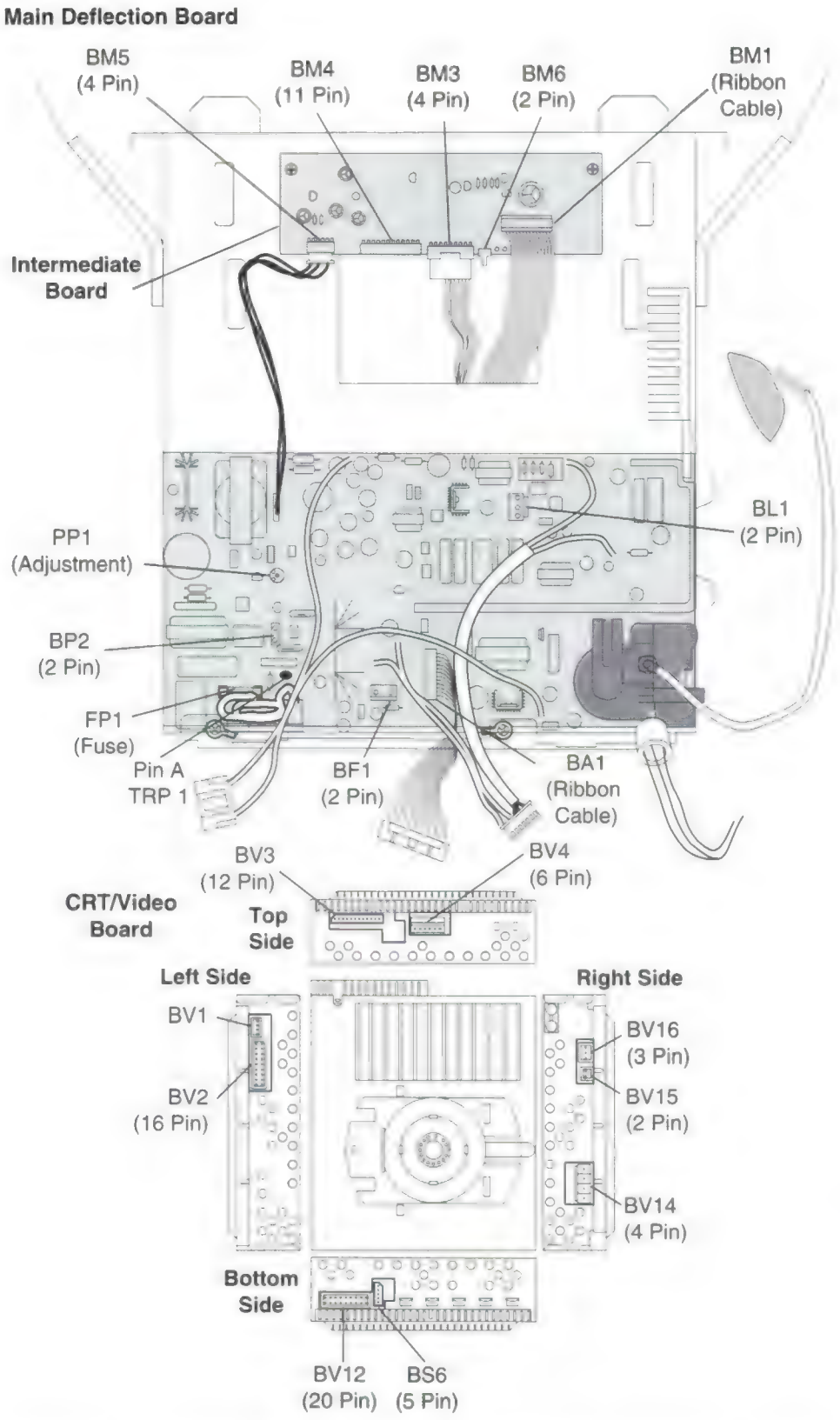


Figure 15. AppleVision 1710 and 1710AV Main Circuit Boards

Parts List

Base, Tilt Swivel, AppleVision Display	922-1452
Bezel, Front	922-1455
Bezel, Sound Enclosure (1710AV only)	922-1602
Board, ADB (1710 only)	922-2262
Board, CRT/Video	661-0914
Board, Intermediate	922-1509
Board, Main Deflection, With Chassis	661-0910
Board, On-Screen Display Switches	922-1511
Board, Sound (1710AV only)	922-1599
Board, Sound Control with Buttons (1710AV only)	922-1597
Cable, 2-Wire, Microphone (1710AV only)	922-1677
Cable, 9-Pin, Sound Board to Intermediate Board (1710AV only)	922-1679
Cable, ADB/Video	922-2023
Cable, Audio (1710AV only)	922-1596
Cable, Intermediate Board to ADB Board (1710 only)	922-2266
Cable, VGA/DDC Adapter	922-1458
Cover, Bottom (1710 only)	922-1457
Disk, AppleVision AV, Ver. 1.0	690-1780
Extender Cables Kit (includes jumper)	076-0529
Housing, Rear	922-1453
Label, FCC ID, 1710AV Display (Pkg. of 5) (1710 AV only)	922-2188
Label, FCC ID, 1710 Display (Pkg. of 5) (1710 only)	922-2189
Manual, User's Guide, AppleVision 1710AV	030-6651
Microphone Assembly (1710AV only)	922-1502
Monitor,[1] AppleVision, Northern Hemisphere, Head Unit	661-1043
Monitor[2], AppleVision, Southern Hemisphere, Head Unit	661-1044
Panel, Left/Right, ADB Board (1710 only)	076-0598
Plate, Blank Bezel (1710 only)	922-2265
Power Cord, 110 V, Smoke	590-0380
Screw Cover, Adhesive Disk (Pkg. of 10) (1710AV only)	922-1790
Screw Cover, Rear Housing Plug (Pkg. of 10)	922-1516
Screw, CR Rec Pan M3x0.5x6	922-0979
Screw, Double Sems, M3x0.5 Pan (Pkg. of 10)	922-1500
Screw, Tap, Hex, Wash, #8-16 (Pkg. of 6)	922-0069
Screw, Tap, M3.5x7mm, Pan T-10 (Pkg. of 10)	922-0117
Screw, Tap, M4x25 mm, Pan, Torx T-15 (Pkg. of 10)	922-1678
Screw, Tap, M4x6 mm, Pan, Pozi (Pkg. of 10)	922-1680
Screw, Tap, Pan, M3x1.06x4 mm (Pkg. of 10)	922-1681
Screw, Tap, Pan, Torx T-8, M4x1.8x12 mm (Pkg. of 10)	922-1675

1. Before ordering this part for replacement, you need authorization from Apple Technical Support, telephone 1-800-919-2775, to confirm a CRT failure. This module does not include the microphone assembly (922-1502), the sound enclosure (922-1495), or the FCC label (922-2188 or 922-2189).
2. See Footnote #1.

Screw, Tapping, Button Head, Torx T-8, #4-20x0.312 (Pkg. of 10) ...922-1676
Screw, Torx T-15, K40 1.79x16, TP Flat (Pkg. of 10) 922-0392
Sound Enclosure (1710AV only).....922-1495
Sound Enclosure, Misc. Hardware Kit (1710 AV only).....076-0515
Speaker, 77mm, 3 W, 13 ohm (1710 AV only).....922-1600
Tool, Ambient Light.....922-1598

First Checklist

Important Many AppleVision 1710AV and 1710 display modules returned for repair are found to be fully operational. Read this checklist before you return a module, and prevent needless module replacement and unnecessary time delays.

- **The Apple Multiple Scan 1710/1710AV Display is not compatible with all computers**.

This display works with both Macintosh and IBM PC-compatible computers. A video card may need to be installed to use this display with some computers. For more information, see the computer manual.

The display is preadjusted to work with any computer that has the following timing ranges:

- Horizontal scan rate of 30-80 kHz
- Vertical refresh rate of 50-120 Hz

For more information on what computers or video cards are compatible with the 1710AV/1710 display, see the Specifications chapter on the *Service Source CD*.

- **The CRT video image will not always resemble a perfect rectangle**.

CRT tolerances allow for some distortion. Additional distortion can be caused by magnetized metal objects (desks, file cabinets, and so on). Move the unit to a different location if you notice video image bowing or bent edges.

- **Jitter, faint lines, or screen movement can be caused by external interference such as electronic devices and fluorescent lights.**

Move the unit to another room or building to help determine if external interference is the source of the problem.

- **A maladjusted screen can mimic the symptoms of deflection board or CRT failures**.

By performing the adjustment procedures, you might determine if one or more of the adjustments is the cause of the problem.

- **CRTs rarely fail**.

Needless CRT replacement can be prevented by checking display adjustments, checking the possibility of other defective modules, and accepting small imperfections in screen display.

Downloading Setup Parameters and Replacing the CRT/Video Board

Important Before removing a defective CRT/video board, check the monitor serial number. If the number is between SG522xxxxxx and SG537xxxxxxx, contact Apple Technical Support (1-800-919-2775, option 6) to expedite replacement of the unit. If the serial number is outside of that range, you must download the display parameter settings before removing the CRT/video board.

The following steps show the procedure for

- Creating (downloading) a parameter settings file
- Replacing the CRT/video board
- Writing (uploading) the display parameters

Note When you connect the monitor to a computer, be sure to connect the ADB cable from the monitor's video cable to the ADB port on the computer.

Download Parameter Settings

Before removing a defective CRT/video board, you must download the display parameter settings.

1. Install jumper on BV1.
2. Open the application called Display Service Utility (see "Diagnostics" in Chapter 1, "General Monitor Information").
3. Select AppleVision 1710AV pattern selections.
4. To download parameters from the CRT/video board, click Create File. A message appears explaining that the process will take about 3 minutes.
5. When the message disappears, a new file called Parameter Settings is created on the same level as the Display Service Utility application.

▲ Caution **To avoid loss of data, do not move or rename the Parameter Settings file.**

6. Shut down the monitor. Unplug the power cord.

Replace the CRT/Video Board

1. Download the current settings before replacing the CRT/video board.
2. Remove the defective CRT/video board and replace it with a new CRT/video board. Refer to the CRT/Video Board topic in the Take Apart chapter of the *Service Source CD*.
3. Install the jumper in connector BV1 (next to the BV2 ribbon cable) on the right side of the CRT/video board.
4. Reattach the power cord. Restart the computer.
5. Open the Display Service Utility and select AppleVision 1710AV pattern selections.

Upload Parameter Settings

1. To upload parameter settings, click Write File. A message appears explaining that the process will take about 3 minutes. During this time, the screen will blink two to three times before the Parameter Settings file is uploaded.

Note If the Write File button is grayed out, this means the application can't find the Parameter Settings file. Make sure you did not move or rename the file.

2. When the message disappears, quit the Display Service Utility.
3. Turn off the power and disconnect the following:
   - Video cable from the computer
   - ADB cable from the monitor
   - Power cord from the monitor
   - Remove jumper at BV1.
4. After about 5 seconds, reattach the cables (excluding the jumper at BV1) and turn on the power.

Adjusting the Display After Replacing the CRT/Video Board

▲ Caution **Perform this procedure only after you've replaced the CRT/video board Rev. B and uploaded the parameter settings.**

After replacing the CRT/video board, some adjustment is necessary. Follow the steps in the procedures on the next page.

Recalibrating White Points

1. After you've rewritten the file (as instructed in the Read Me First file of the Display Service Utility), restart the system.
2. Open the AppleVision Setup control panel and select Color.
3. Select the default 9300 white point and click Recalibrate.
   - If you later choose another white point (such as 6500 or D50), you must click Recalibrate for the changes to take effect.
   - If the display looks blurry after recalibrating, adjust convergence as described in the next section.
   - If you click Recall Factory Settings, it might be necessary to perform a minor convergence adjustment using AppleVision Setup.

Adjusting Screen Convergence

1. Use the AppleVision Setup control panel to select Geometry. Select Convergence and set the convergence for the best center-of-screen appearance. Refer to "Convergence" in the "Adjustments" section for more information.
2. If center-of-screen appearance is still blurry, use a standard hex tool to adjust H-Stat (lower-left side of CRT/video board.) (Refer to Figure 21A).
3. If center-of-screen appearance is good, but the top/bottom convergence is blurry, use the plastic adjustment tool to adjust the top and bottom convergence (back of CRT/video board).
4. If the screen is still blurry after adjusting convergence, one of the CRT socket wires may be improperly secured. Refer to the Take Apart chapter on *Service Source CD* to secure the red and white wires correctly in the socket.

Adjusting Screen Geometry

If the screen is displaying keystoning (when the normal rectangular shape of the video appears uneven–either the top edge is shorter than the bottom edge, or vice versa) open the Display Service Utility, select AppleVision 1710AV pattern, and click the Adjust Geometry button. Using the keystone slider control, you can adjust the width of the top and bottom of the screen.

Symptom/Cure Chart

Use the following symptom cure chart as a troubleshooting guide. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see Chapter 1, "General Monitor Information."

The flowcharts (Figures 16–20) and Figure 21, "Troubleshooting Test Points," that follow this Symptom/Cure Chart provide additional information for identifying problems and possible cures. Use the flowcharts in conjunction with this Symptom/Cure Chart for best results.

For additional assistance, contact Apple Technical Support.

No video (See Figure 16)	**Solutions**
No video (screen is black); power indicator light on	1. Check the monitor serial number. If the number is between SG522xxxxxx and SG537xxxxxx, contact Apple Technical Support (1-800-919-2775, option 6) to expedite replacement of the unit. 2. Ensure the monitor's video cable and ADB cable are properly connected to the computer or video card. If the cables are properly connected and there is still no video image, the CRT/video board might be defective. **Caution:** Before you replace the CRT/video board, you must attempt to download the parameter settings as follows outlined in Steps 2–8. 3. Shut down monitor. Unplug power cord. 4. Install jumper in connector BV1 (next to the BV2 ribbon cable) on right side of the CRT/video board. 5. Connect monitor's video cable and ADB cable to computer that supports two monitors. 6. Connect a known-good monitor (any type) to computer. This monitor is the "boot" monitor. 7. Check all cables for secure connections. 8. Restart the computer from the boot monitor. 9. Run the Display Service Utility (from the companion *Service Source CD*) and create parameter file. • If the parameter file is completed successfully, replace the CRT/video board, install the jumper, and upload the parameter file using the Display Service Utility. • If the parameter file cannot be completed successfully, call Apple Technical Support.

No video (screen is black); power indicator light off	1. Ensure the monitor's video cable and ADB cable are properly connected to the computer or video card. 2. Check the monitor serial number. If the number is between SG522xxxxxx and SG537xxxxxx, contact Apple Technical Support (1-800-919-2775, option 6) to expedite replacement of the unit.

Video	**Solutions**
Narrow (one-inch) vertical bar in the center of the screen	Replace main deflection board.
Two thin gray horizontal lines are visible across bottom third and top quarter of the screen	The lines are common to the design of Trinitron monitors. Do not replace any modules.
A thin red line is visible on the outer-left, outer-right, or top of the screen	Adjust convergence using the AppleVision Setup control panel.
Screen shows predominant color after recalibrating and restarting the display; cannot correct color using AppleVision Setup	The solution for this symptom is known as reinitializing the Parameter RAM (PRAM). It requires reinstallation of the AppleVision software. Follow these steps to reset the PRAM: 1. Open Preferences in System folder. 2. Find the Display Preferences file. Drag it to the Trash. 3. Turn off power for computer and monitor. Disconnect ADB cable from computer. Disconnect power cord and video cable from display. Wait 5 seconds. 4. Reconnect all cables. 5. Press and hold Command-Option-P-R keys, and restart computer and monitor. The screen may flash a few times. Release keys when you see "Welcome to Macintosh" message. 6. Reinstall AppleVision software.

Miscellaneous	**Solutions**
Microphone doesn't work	1. Without removing rear housing, disconnect microphone from bezel of AppleVision 1710AV Display. 2. Connect microphone to known-good AppleVision 1710AV Display to verify whether it works. • If microphone doesn't work, replace it. Because microphone cable might also be damaged, go to Step 3 to check it. • If microphone works, check microphone cable (as described in Step 3).

3. With microphone disconnected, use DC voltmeter to check contacts on microphone connector that is secured inside monitor bezel. The voltmeter should measure 8 V DC.
4. If voltmeter reads 0 V DC, remove sound enclosure, connect extension cables to head unit, and measure voltage at the microphone contact (BA10) on the sound board.
    - If the voltmeter measures 8 V DC, replace the microphone cable.
    - If the voltmeter measures 0 V DC on the sound board at BA10, replace the sound board.

While in sleep mode, power indicator light randomly flashes and monitor powers up and shuts down every few seconds; speakers may emit clicking sound

1. Check the computer or video card. Some AppleVision 1710AV displays may not function as intended while in Energy Saver mode when connected to a Power Macintosh 7200, 7500, 8500, or 9500 computer or some third-party video cards.
2. Check the monitor serial number
    - If the number is between SG522xxxxxx and SG537xxxxxx, turn energy saver off and use Sleep or Shut Down option under Special menu instead. Contact Apple Technical Support (1-800-919-2775, option 6) to expedite replacement of the unit.
    - If the number is SG537xxxxxx or greater, the display should function normally in Energy Saver mode.

High-Voltage Check

This high-voltage check is a required procedure in the No Video Flowchart (Figure 16). When the monitor has a No Video condition, the high-voltage check would be the first step in ruling out a main deflection board problem.

▲ Caution **Do not attempt this procedure without the Apple high-voltage probe. Use only the Apple high-voltage probe. Other high-voltage probes will not give accurate readings for this procedure.**

▲ Warning **Read all of the warnings, notes, and steps of this procedure before beginning.**

- **Voltage at the anode, with the power on, can cause serious injury. Double-check all multimeter connections before taking the reading.**
- **Probe the anode carefully. Serious damage and injury may occur if the anode is knocked off while the CRT is charged.**

1. Attach the Apple high-voltage probe to the multimeter and attach the ground wire to the chassis.
2. Be sure the monitor is attached to a computer and has power.
3. Turn on the monitor.
4. Carefully insert the probe under the anode cap.
5. The reading should be 26 VDC on the meter. This is actually 26 kV. Most of the voltage is across the high-voltage probe.

▲ Warning **Do not remove the probe from under the anode cap until power is turned off. Injury or damage to equipment may occur.**

6. Turn off monitor.
7. Unplug monitor.
8. Remove the probe from under the anode cap.
9. See Figure 16, "No Video Flowchart."

No Video Flowchart

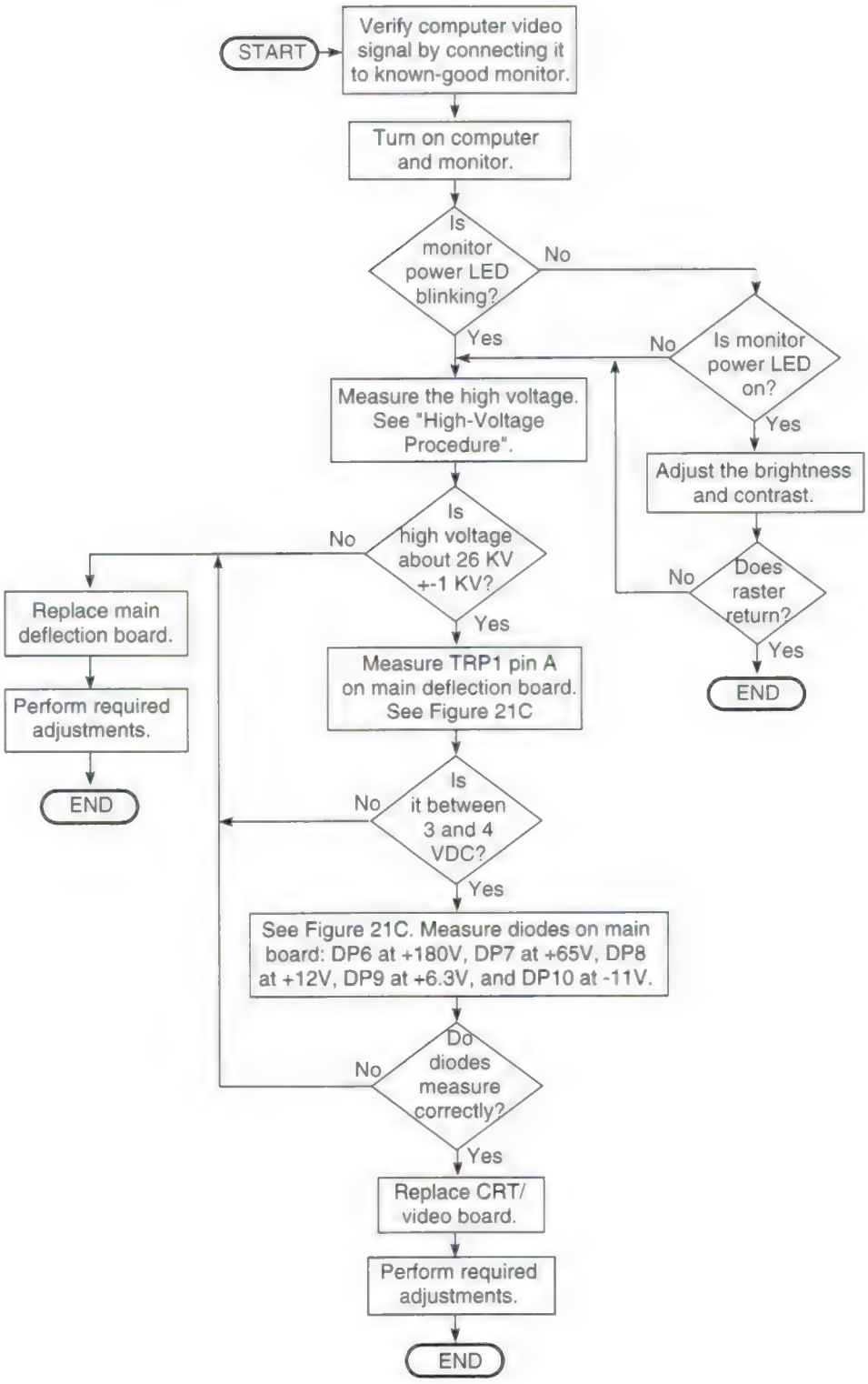


Figure 16. No Video Flowchart

Geometry Flowchart

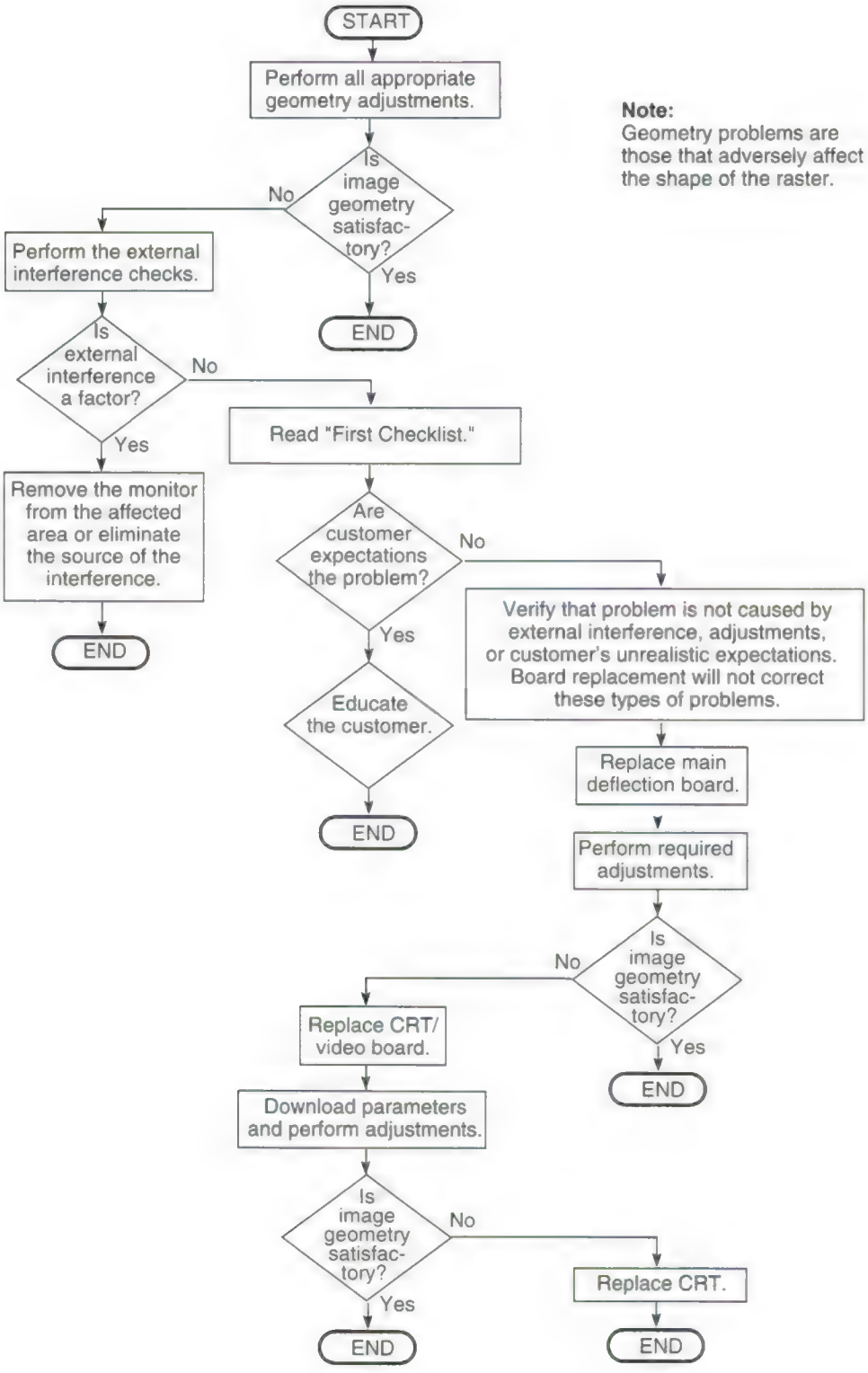


Figure 17. Geometry Flowchart

Convergence Flowchart

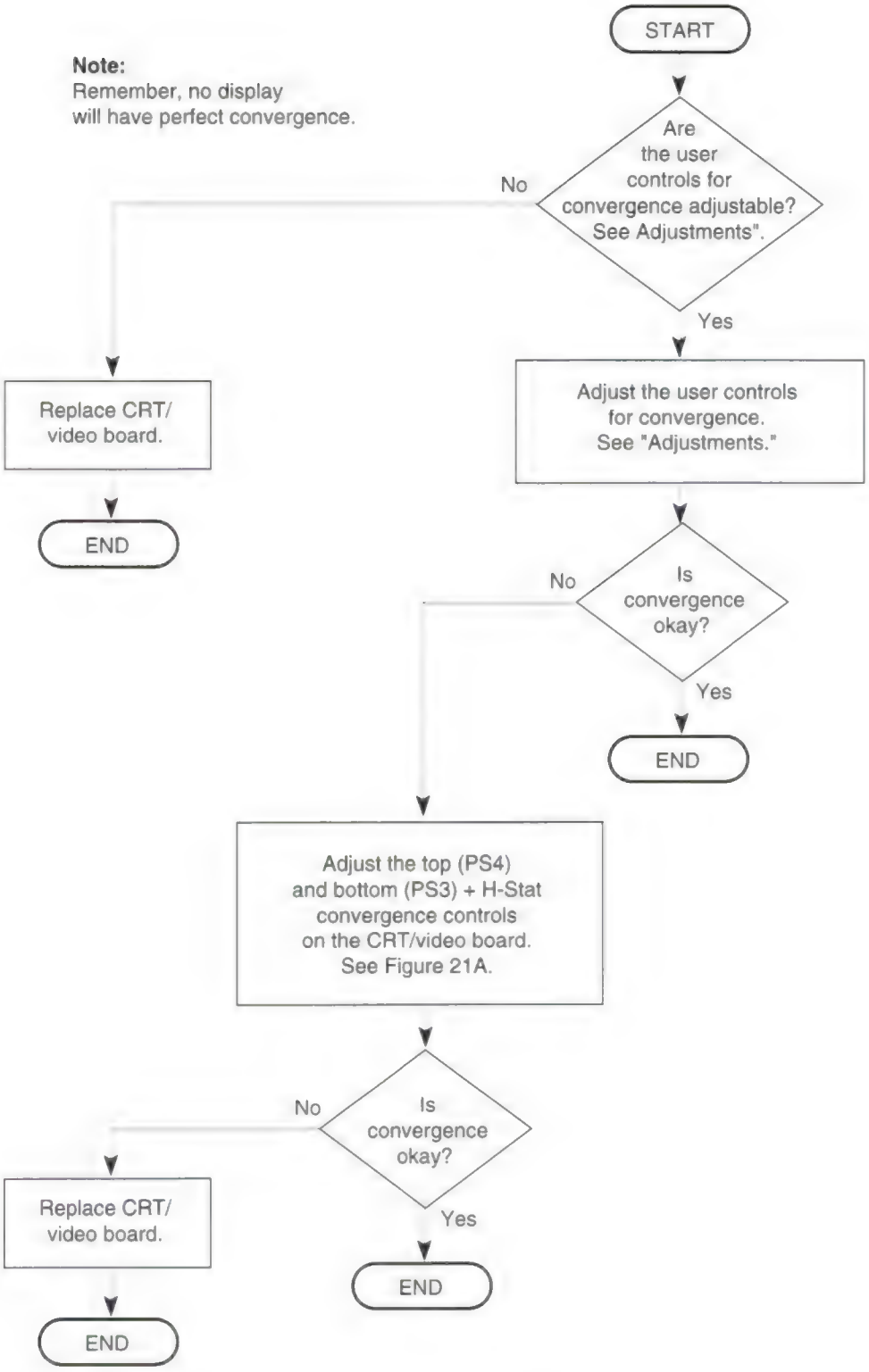
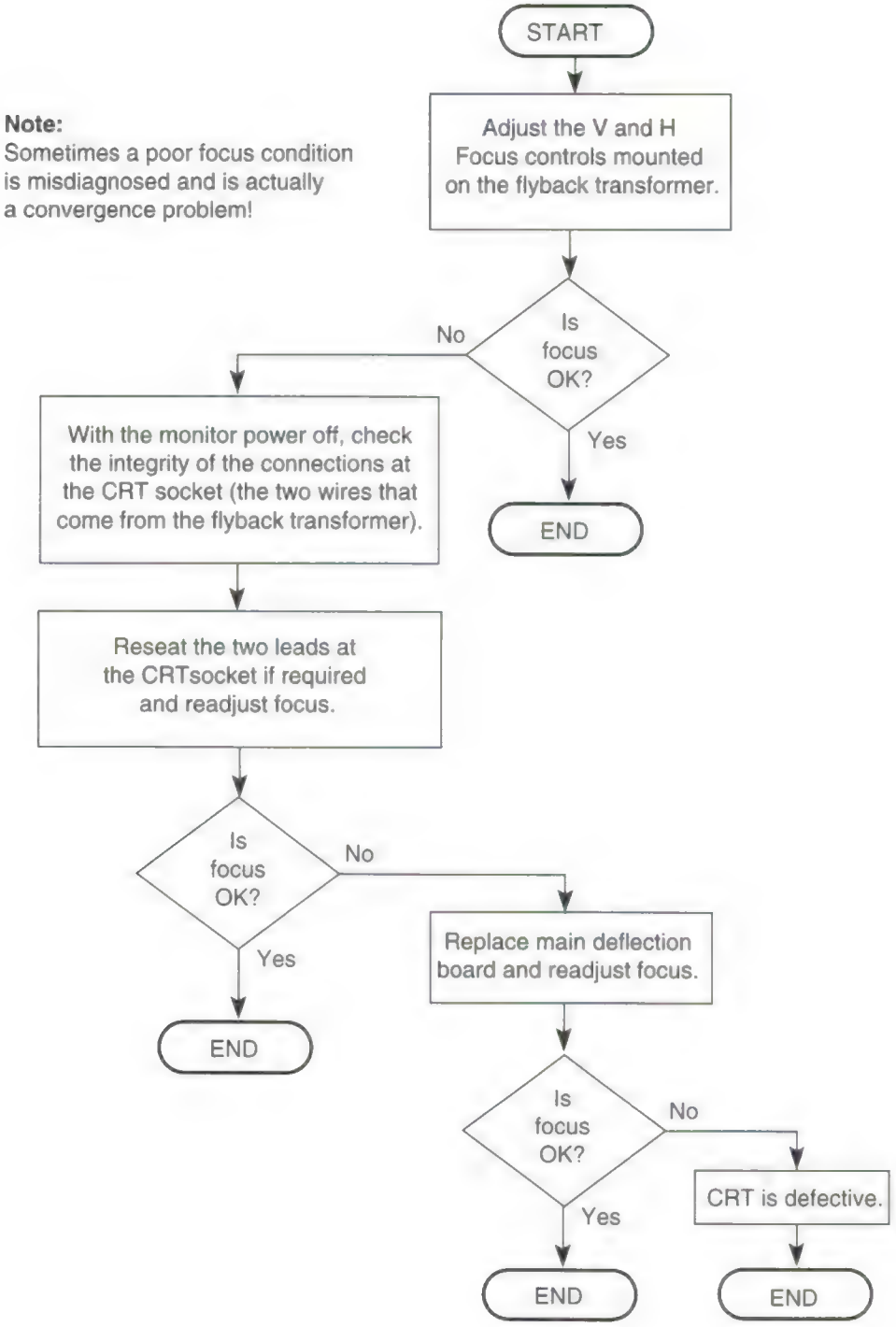


Figure 18. Convergence Flowchart

Focus Flowchart



Note:
Sometimes a poor focus condition is misdiagnosed and is actually a convergence problem!

Figure 19. Focus Flowchart

Intermediate Board Functional Check Flowchart

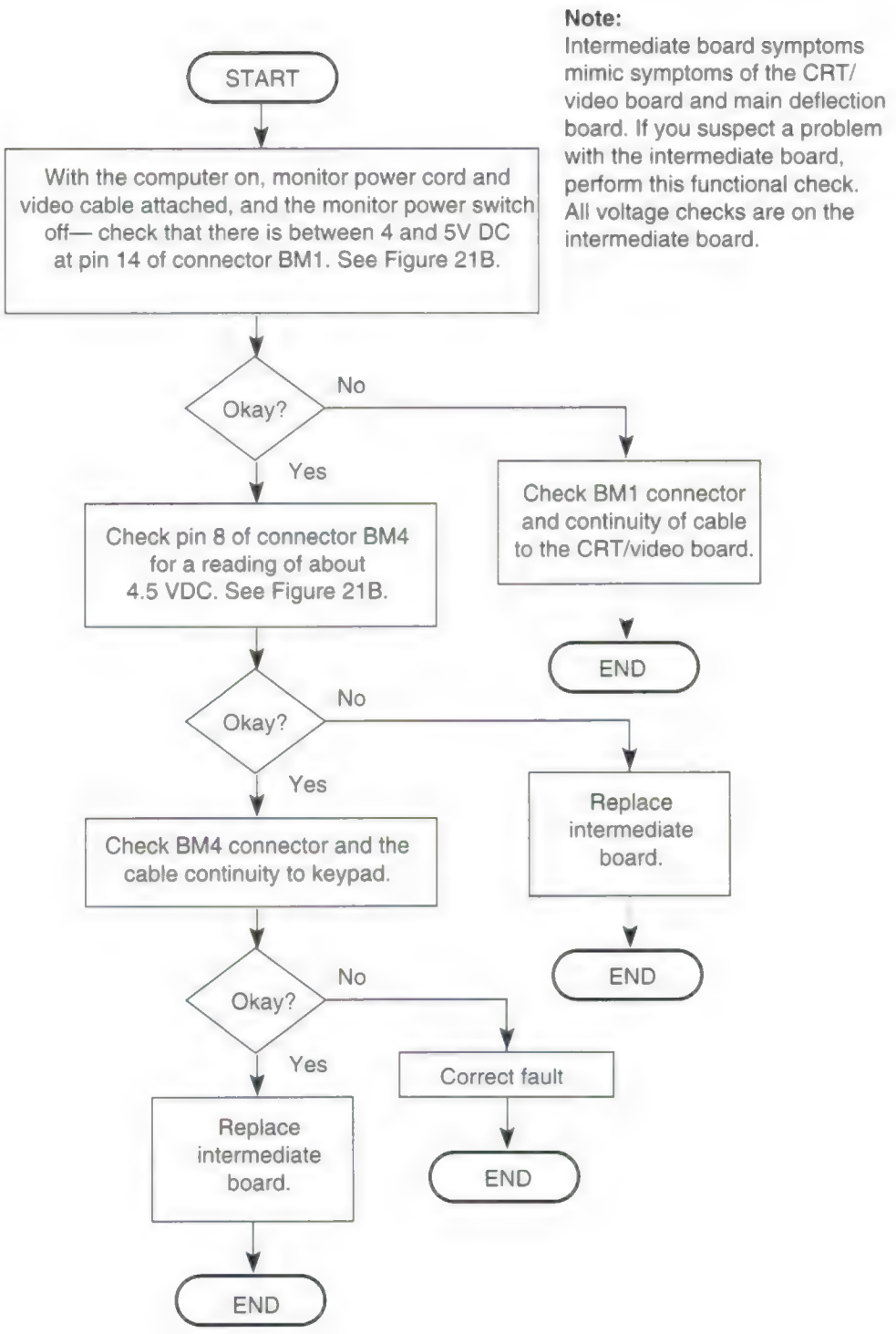


Figure 20. Intermediate Board Functional Check Flowchart

The following illustrations are referenced in the preceding troubleshooting flowcharts. Use these illustrations to locate test points mentioned in the flowcharts.

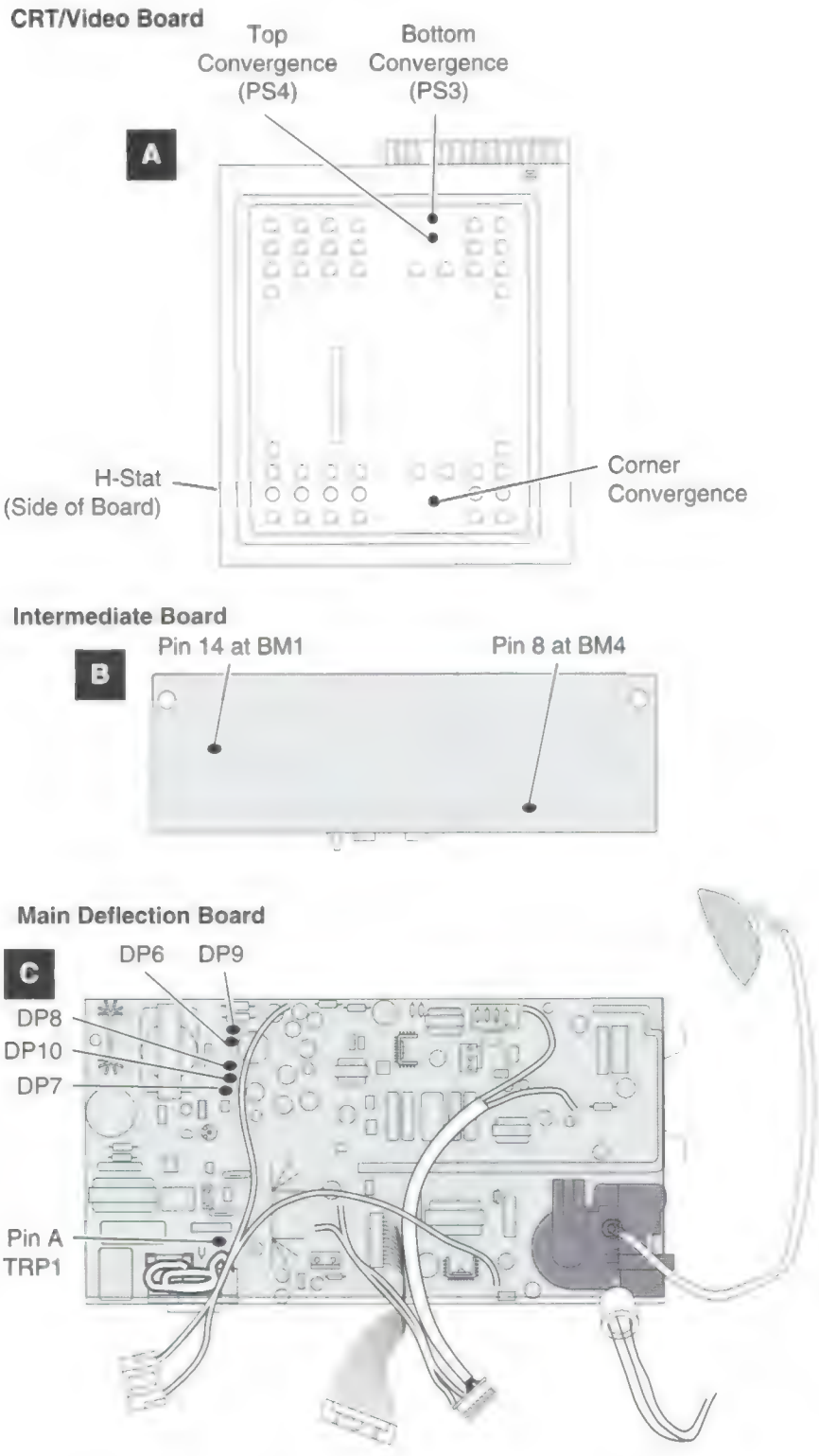


Figure 21. Troubleshooting Test Points

Using the AppleVision Setup Control Panel

You can adjust the screen image using the buttons on the front of the display (see Figure 22), or you can use the AppleVision Setup control panel. Most of the procedures in this chapter require use of the AppleVision Setup control panel.

Verify that you have installed the Macintosh software that came with the display and verify that you have connected the monitor cable's ADB connector to your computer's ADB port.

If you need more information, or you are using the monitor with an IBM PC-compatible computer, refer to the *User's Guide*.

From the AppleVision 1710AV Setup control panel software, you can select four main buttons: Display, Geometry, Color and Sound. By selecting a particular button, you can make the adjustments shown in Table 7.

Table 7. AppleVision 1710AV Setup Control Panel

Display Button	Geometry Button	Color Button	Sound Button
• Contrast • Brightness	• Height/Width • Position • Rotate • Convergence • Overscan • Recall Factory Settings	• White Point • Gamma Curve • Ambient Light • Import/Export • Preferences • Recalibrate	• Sound Input • Gain • Sound Output • Volume • Treble • Bass • Headphone Volume Muting

Front Display Controls

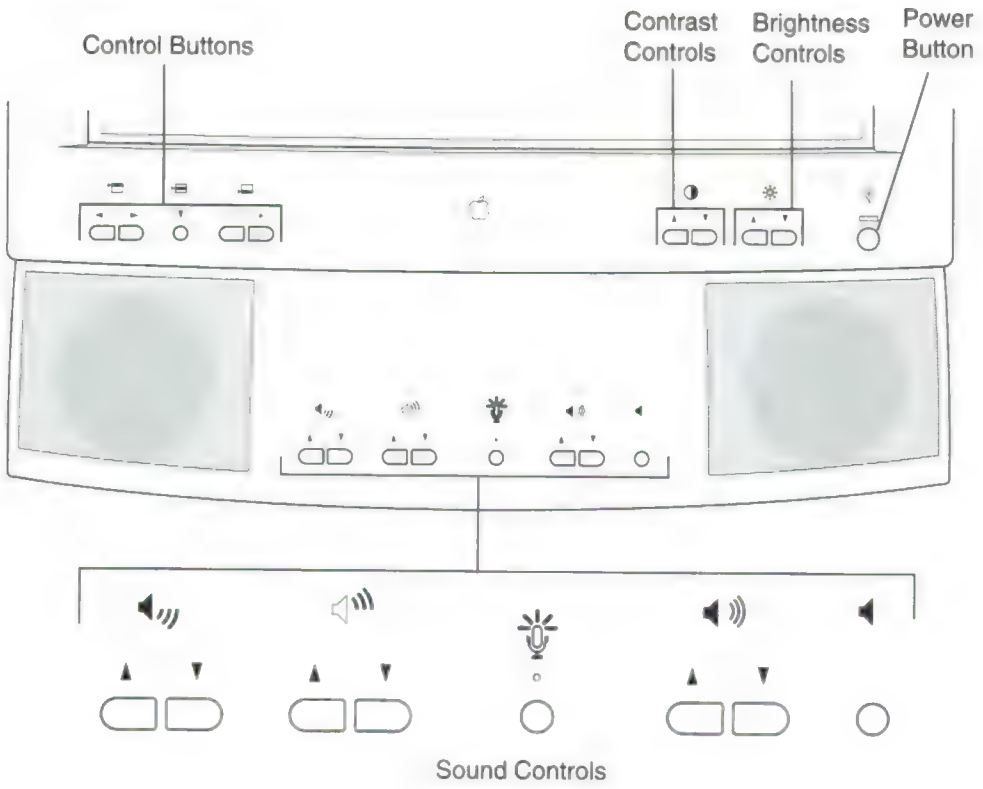


Figure 22. AudioVision 1710AV Front-Panel Controls

Brightness and Contrast

The two ways to adjust the brightness and contrast are by using the controls on the right side of the front panel (see Figure 22) or by using the AppleVision Setup control panel.

Using the controls on the right side of the front panel:

- Press the down button to decrease the brightness or contrast.
- Press the up button to increase the brightness or contrast.

Note Before you begin the following adjustments, install the AppleVision Setup software.

Using the AppleVision Setup controls:

1. Open the AppleVision Setup control panel from the Apple menu.
2. Click the Display button (see Figure 23).
3. Drag the slider controls left or right to decrease or increase the brightness and contrast.

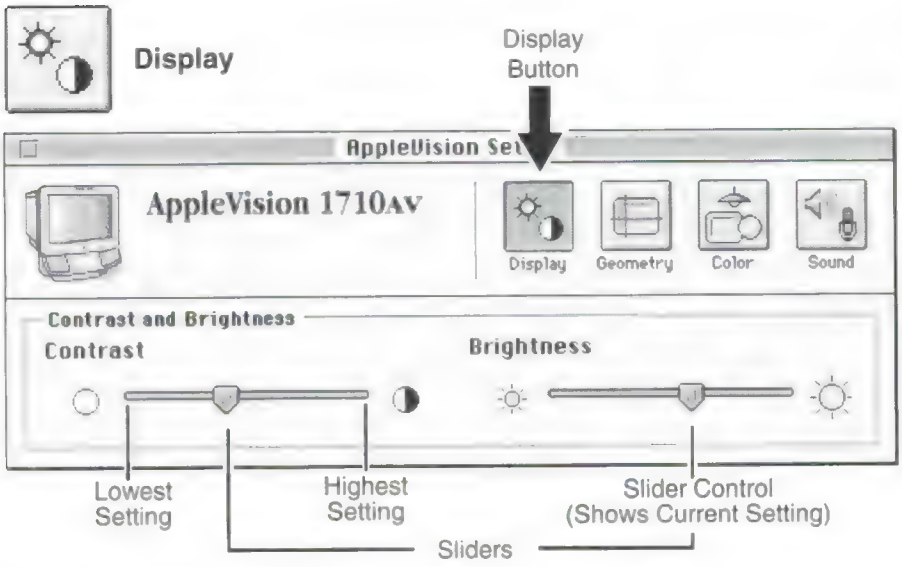


Figure 23. AppleVision Setup Control Panel Display Button

Height and Width

1. Open the AppleVision Setup control panel.
2. Click the Geometry button (see Figure 24A).
3. Click the Height/Width button (see Figure 24A).
4. Move the pointer over the screen rectangle in the picture of the display (see Figure 24B). Drag the left or right side of the screen rectangle to change the width. Drag the top or bottom edge of the screen rectangle to change the height.

Note Instead of dragging the screen rectangle, you can adjust height and width by clicking the arrow buttons (see Figure 24B) for incremental movement.

Normal height and width leaves a black border of approximately 1/2 inch around the screen image.

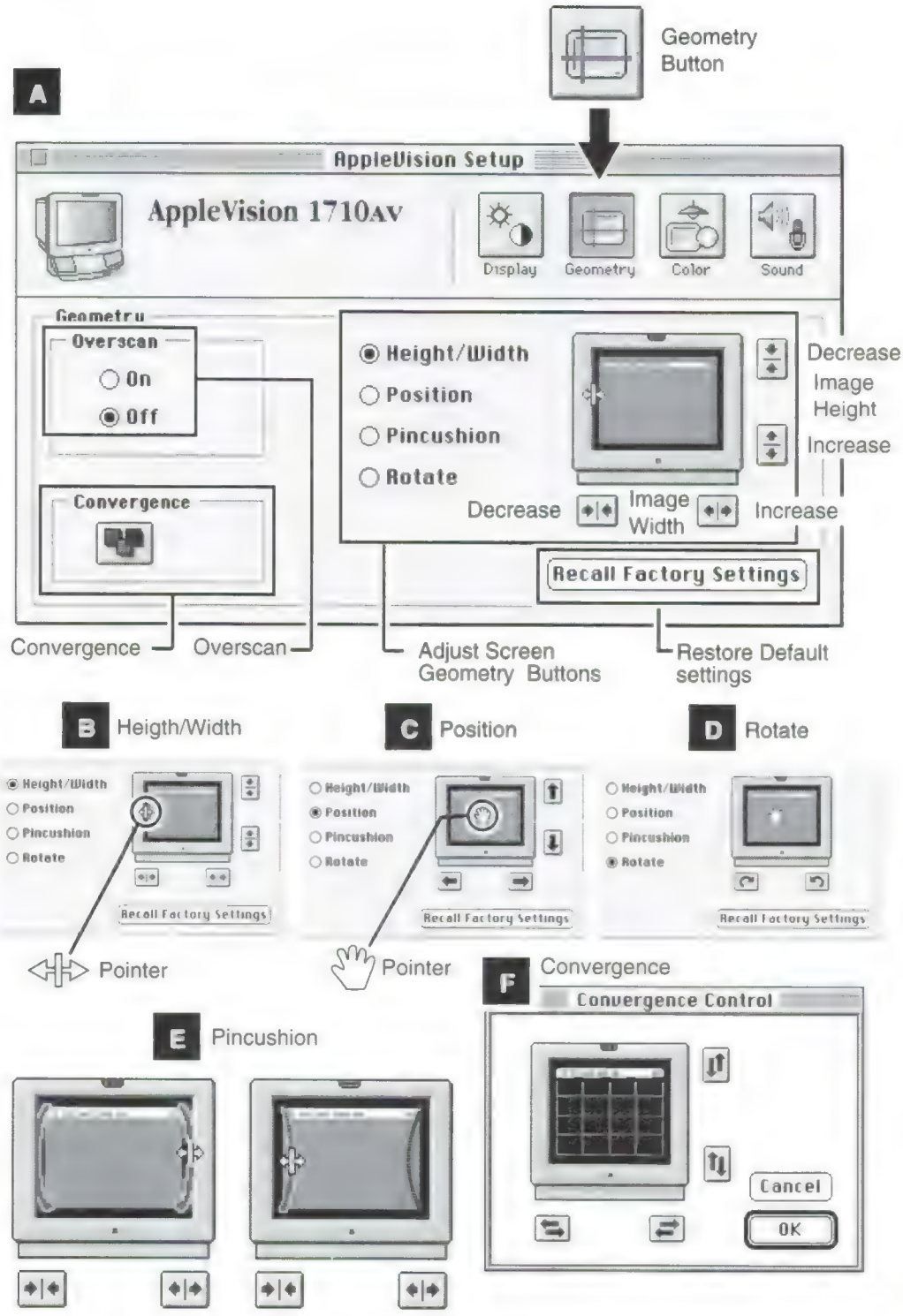


Figure 24. AppleVision Setup Control Panel Geometry Button

Centering

1. Open the AppleVision Setup control panel from the Apple menu.
2. Click the Geometry button (see Figure 24A).
3. Click the Position button (see Figure 24A) and move the pointer over the picture of the display (see Figure 24C).
4. Drag the screen rectangle to center the image.

Note Instead of dragging the screen rectangle, you can also adjust height and width by clicking the arrow buttons for incremental movement.

Pincushion

1. Open the AppleVision Setup control panel from the Apple menu.
2. Click the Geometry button (see Figure 24A).
3. Click the Pincushion button (see Figure 24A).
4. Move the pointer over the picture of the display.
5. Drag the left or right side of the screen rectangle to adjust the image (see Figure 24E).

Note Instead of dragging the screen rectangle, you can adjust the shape of the image by clicking the arrow buttons for incremental movement.

Rotating

1. Open the AppleVision Setup control panel from the Apple menu.
2. Click the Geometry button (see Figure 24A).
3. Click the Rotate button (see Figure 24A).
4. Move the pointer over the picture of the display.
5. Drag the screen rectangle clockwise or counterclockwise to rotate the image (see Figure 24D).

Note Instead of dragging the screen rectangle, you can rotate the image by clicking the arrow buttons for incremental movement.

Convergence

1. Open the AppleVision Setup control panel from the Apple menu.
2. Click the Geometry button (see Figure 24A).
3. If you want to adjust the RGB color convergence, click the Convergence button (see Figure 24A). A Convergence Control window (see Figure 24F) appears.

Note When you adjust convergence, refer to the center of the screen on the grid outside the Convergence Control window. If necessary, move the window away from the center of the screen.

4. Click the arrow buttons to adjust convergence. When convergence is set properly, the lines in the grid are aligned vertically and horizontally, and the image is clear and distinct.
5. Click OK to save your convergence changes and close the Convergence control window.

Overscan

Note Overscan is typically used when viewing a movie, or when you want the screen image to span the entire screen area.

1. Open the AppleVision Setup control panel.

Important When overscan is on, you cannot adjust screen geometry or convergence, and you might not be able to choose commands from the menu bar at the top of the screen.

2. Click the Geometry button (see Figure 24A).
3. To turn Overscan on, click On (see Figure 24A).
4. To turn Overscan off, click Off, and the screen image returns to its previous size.

Factory Settings

Important Recalling the factory settings resets only the four geometry controls and convergence. The screen image returns to the factory preset levels of geometry (height/width, position, pincushion, rotation) and convergence for the current screen resolution. Adjustments you make in the Display, Color, or Sound windows are not reset.

1. Open the AppleVision Setup control panel.
1. Click the Geometry button (see Figure 24A).
2. Click the Recall Factory Settings button located in the bottom-right corner of the screen (see Figure 24A).

Color Adjustments

This section describes how to fine-tune the color on the display. In most cases, you won't need to adjust colors. However, when working with detailed graphics, you may need to match display colors as closely as possible to colors created by a printer or other device. Use the Color window in the AppleVision Setup control panel (see Figure 25) to adjust colors on your display.

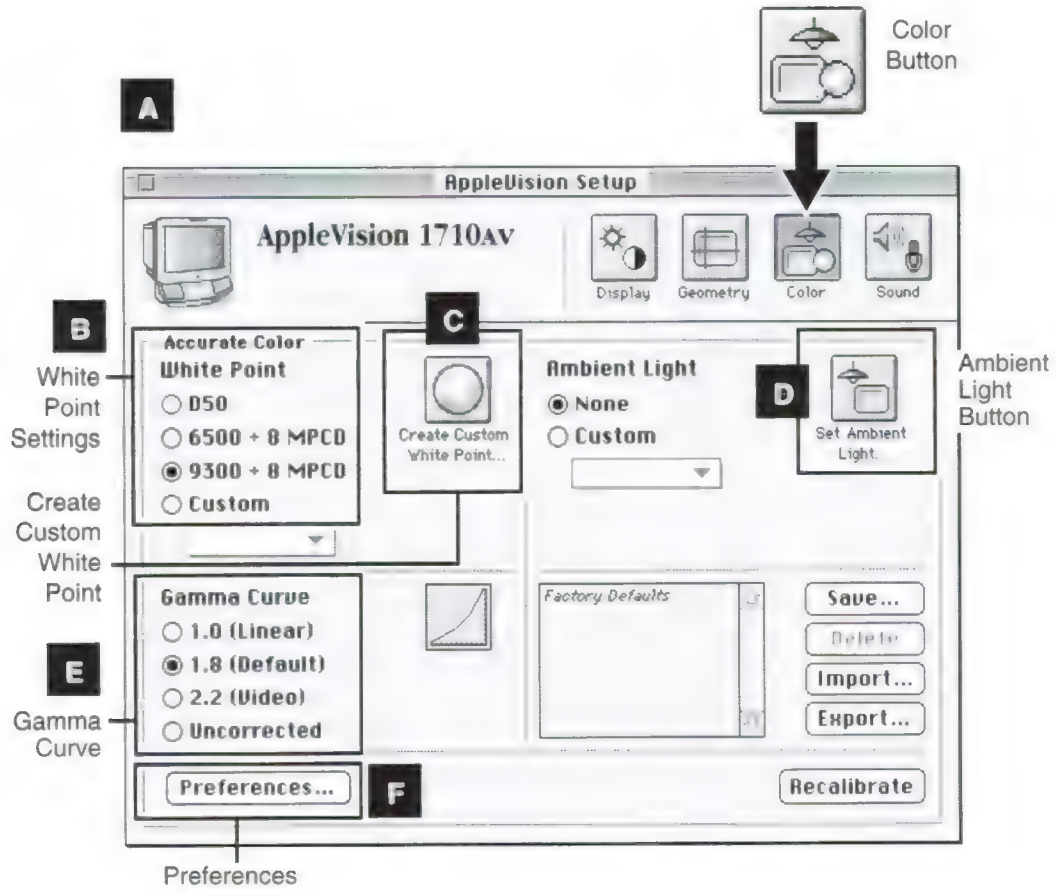


Figure 25. AppleVision Setup Color Button

Setting a White Point

White point is a measure of the color content of the light. All lights (including display light) have a white point. Lighting used in graphic arts is based on a white point of 5,000 degrees Kelvin (or D50).

1. Open the AppleVision Setup control panel.
2. Click the Color button (see Figure 25).
3. Click one of the standard white points (see Figure 25B):
   - D50=graphic arts standard
   - 6500=midday sun
   - 9300=Macintosh displays and high-definition TV

Note Changes won't take effect until you click Recalibrate.

4. Click Recalibrate.

Creating a Custom Kelvin White Point

1. Open the AppleVision Setup control panel.
2. Click the Color button.
3. Click Create Custom White Point button (see Figure 26).
4. Click Kelvin if you want to use Kelvin temperatures.
5. Drag the slider control (see Figure 26A) to select the temperature (4100 to 9300).
6. Click Save, and name the custom white point. The name appears in the White Point Custom menu.
7. Click Recalibrate.

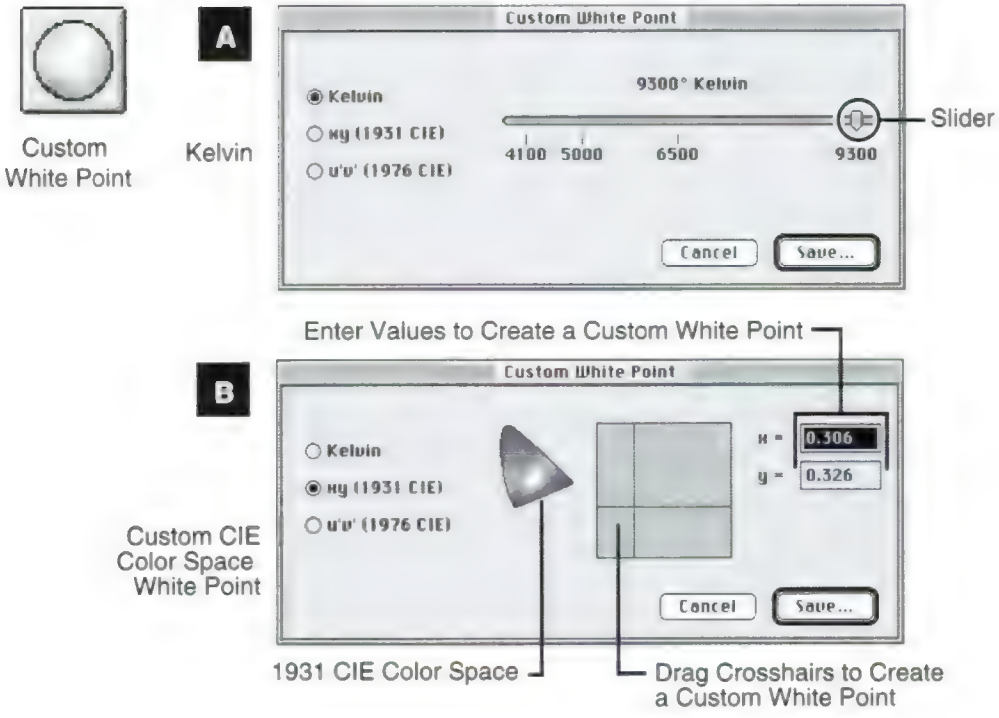


Figure 26. Color Button White Point Setting

Creating a Custom CIE Color Space White Point

1. Open the AppleVision Setup control panel.
2. Click the Color button.
3. Click Create Custom White Point button (see Figure 26B).
4. Click
   - xy (1931 CIE) (see Figure 26B) if you want to use 1931 CIE standards
   - u'v' (1976 CIE) (see Figure 26B) if you want to use 1976 CIE standards
5. Drag crosshairs to create custom white point or enter values (to define a custom white point) in the fields to the right of the crosshairs.
6. Click Save, and name the custom white point.
7. Click Recalibrate.

Adjusting for Ambient Light

All light falling on the front of the display is called *ambient light*, and can change how colors appear. To get a truer color rendering, set the white point for the display, and then correct for ambient light conditions in the room.

1. Open the AppleVision Setup control panel.
2. Click the Color button.
3. Locate the ambient light tool (see Figure 27) that came with the display.

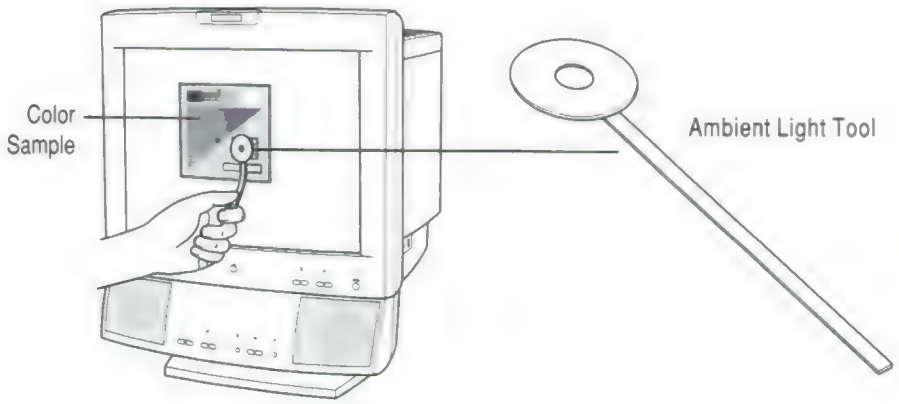


Figure 27. Ambient Light Tool

Important Store the ambient light tool in its protective sleeve when you're not using it. If the gray color fades, you'll get incorrect ambient light readings.

4. Click Set Ambient Light button (see Figure 25D).

   The screen's color depth must be set to "Millions of Colors." Refer to the section, "The Control Strip," in this chapter.

5. Hold the ambient light tool against the display face, over the square color sample (see Figure 28).

6. Drag the picker (see Figure 28) in the color triangle until the color sample is similar to the gray color on the ambient light tool.

7. Drag the brightness slider (see Figure 28) until the color sample matches the ambient light tool exactly.

8. Click Save, and name the new setting. The name appears in the Ambient Light Custom menu.

9. Click Recalibrate.

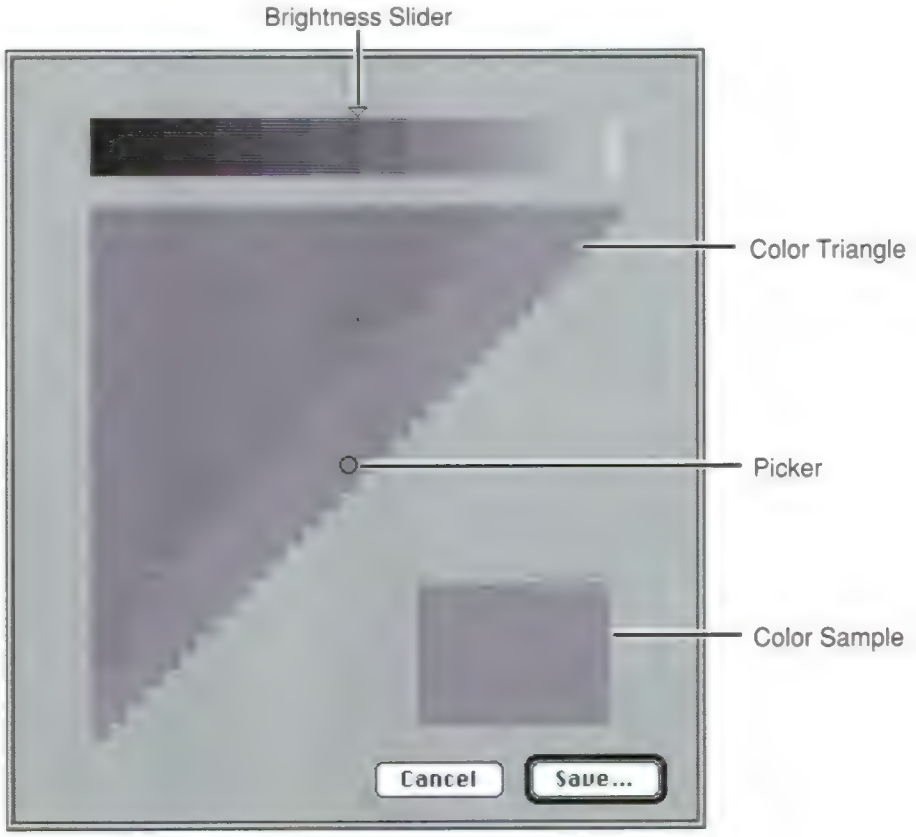


Figure 28. AppleVision Control Panel Color Picker

Adjusting Gamma Curve

The relationship between the input value and output luminance on the display is represented by *gamma curve*. At a low gamma value, colors are washed out. At a high gamma value, colors have more contrast.

Important The gamma value selected depends on the image being displayed. Color images with important details in highlights or shadows need a different gamma value than standard images.

1. Open the AppleVision Setup control panel.
2. Click the Color button.
3. Select a standard gamma value (see Figure 25E). Notice how the picture of the curve changes when you select a gamma value.
4. Click Recalibrate.

Recalibrating Automatically

You can set preferences in the AppleVision Setup control panel so that the display is recalibrated automatically every two weeks, or when you change brightness, contrast, screen geometry, or screen resolution.

1. Open the AppleVision Setup control panel.
2. Click the Color button.
3. Click the Preferences button (see Figure 25E). A "Preferences" window appears (see Figure 29).
4. Select the recalibration preferences (see Figure 29).

Important If you select Time (recalibration every two weeks), your work can be interrupted without asking.

5. Click OK.

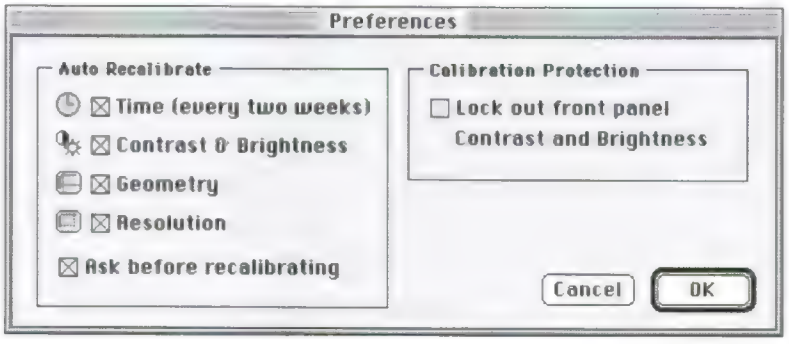


Figure 29. AudioVision Setup Control Panel Recalibration Preferences

Saving Color Settings

You can save different combinations of white point, gamma curve value, and ambient light in named color settings.

To save a color setting:

1. Open the AppleVision Setup control panel.
2. Click the Color button (see Figure 30A).
3. Make sure white point (see Figure 30C), gamma curve (see Figure 30B), and ambient light (see Figure 30E) are set as desired.

Optional

4. Click Recalibrate (see Figure 30D) to see how the settings change the screen image.
5. Click Save, and name the new color setting.
6. Click Save, and the new name appears in the settings list.

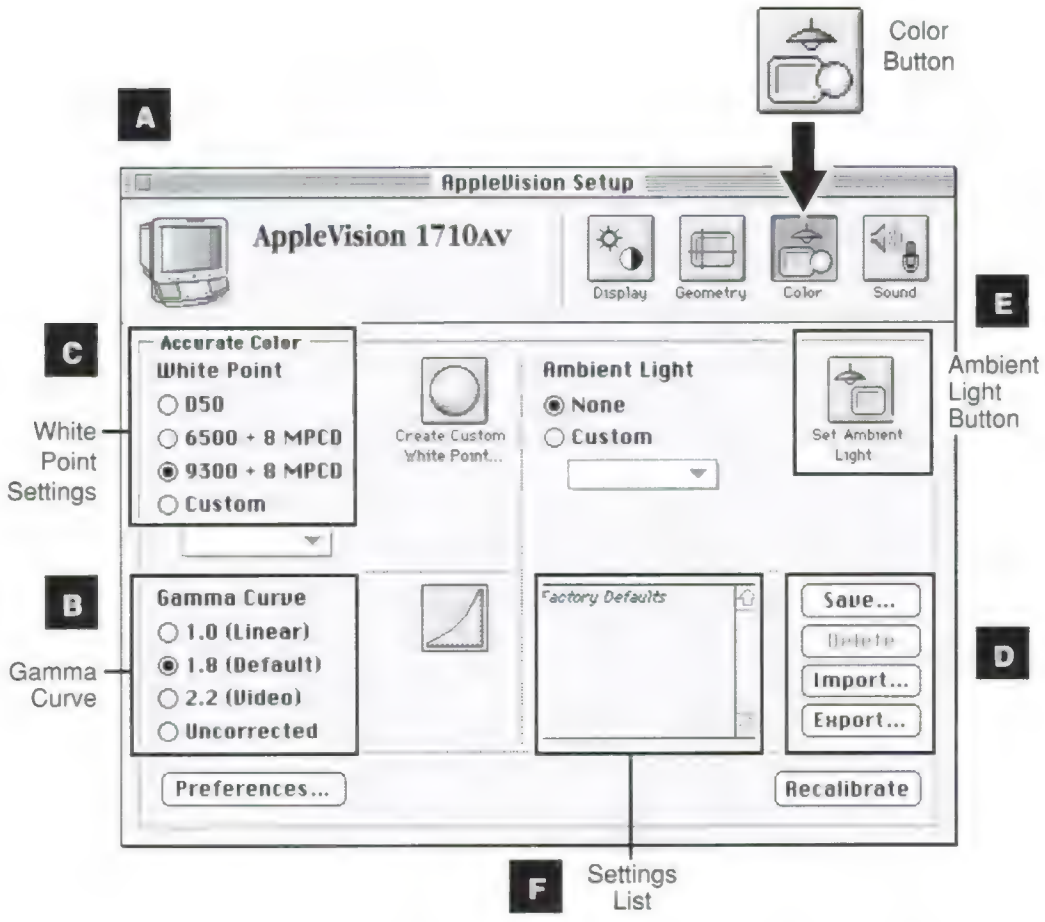


Figure 30. AudioVision Setup Saving, Using, and Deleting Color Settings

Using or Deleting Existing Color Settings

To use or delete a previously saved color settings:

1. Open the AppleVision Setup control panel.
2. Click the Color button (see Figure 30A).
3. Click a name in the settings list (see Figure 30F).
4. Click Recalibrate (to use an existing setting) or click Delete (to delete a color setting from the list).

ColorSync Profiles

The AppleVision display allows you to create a ColorSync profile that describes the white point and gamma value for your display.

Note The ambient light setting is not saved as part of the ColorSync profile because ambient light changes as the physical location of the display changes. So, the ambient light setting for one display will not be correct for another display.

Custom color settings can be shared with any other display that supports Apple's ColorSync color-matching system. ColorSync ensures that the colors shown on the display closely match the colors that are printed or scanned.

Exporting a ColorSync Profile

To send a custom color setting to another display:

1. Open the AppleVision Setup control panel.
2. Click the Color button.
3. Verify that white point and gamma curve are set as desired.
4. Click Recalibrate (see Figure 30D).
5. Click Export (see Figure 30D).
6. Enter a name for the profile, and click Save.

Importing a ColorSync Profile

To select a custom color setting from another display:

1. Open the AppleVision Setup control panel.
2. Click the Color button.
3. Click Import (see Figure 30D).
4. Select the profile you want and click Open and then click Recalibrate.

Important To get truer color rendering, adjust for ambient light after importing a ColorSync profile.

Sound Adjustments (1710AV only)

Before you make changes to the Sound window of AppleVision Setup, choose Control Panels from the Apple menu. Open the Sound control panel to select a sound input source, select a sound output device, and adjust volume.

Refer to Chapter 5, "Using Sound and Video," from the *User's Guide* for more information.

Selecting a Sound Input Source

Verify that you have selected a sound input port (see Figure 31B) on the computer before selecting the sound input source for your display.

1. Press any control button to open the AppleVision Setup control panel.
2. Click the Sound button (see Figure 31A).

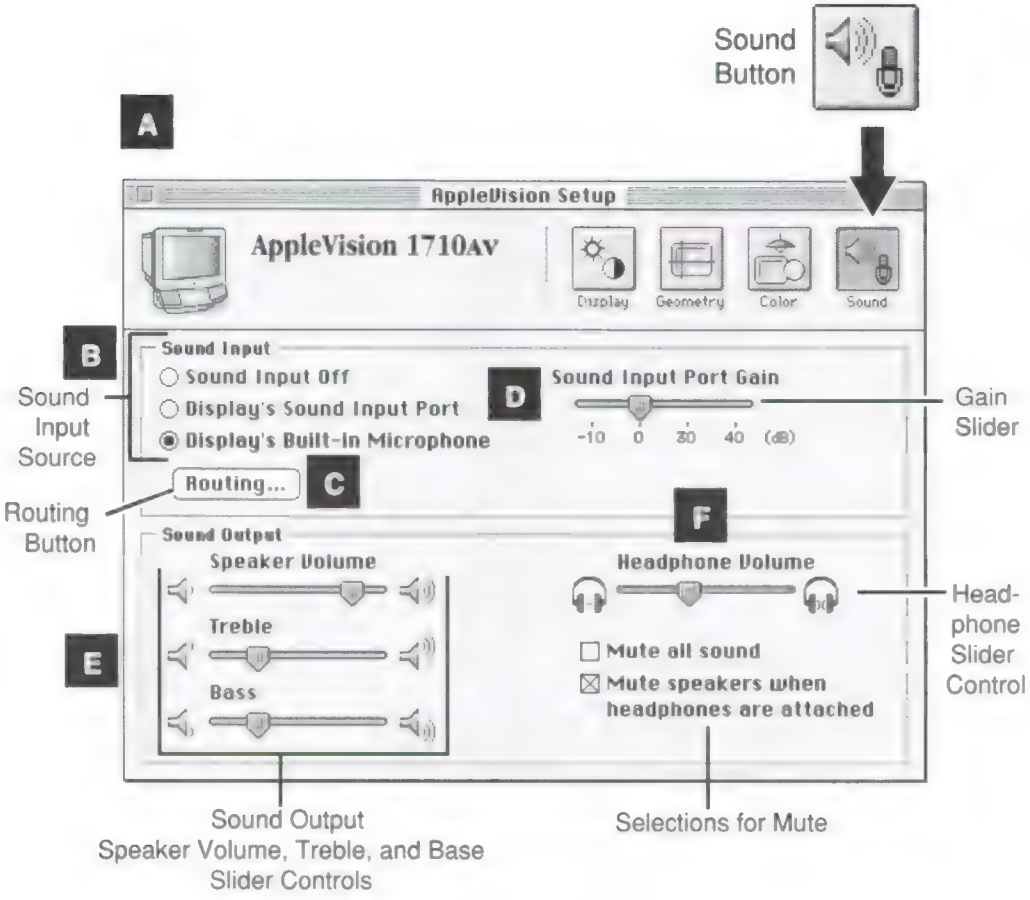


Figure 31. AudioVision Setup Sound

3. Click
   - "Sound Input Off" (see Figure 31B) if you want to disable sound input on the display
   - "Display's Sound Input Port" (see Figure 31B) if you want to use an audio device attached to the display's input port
   - "Display's Built-In Microphone" (see Figure 31B) if you want to use the display's built-in microphone
4. If you select "Display's Sound Input Port," drag the Sound Input Port Gain slider (see Figure 31D) to set the desired gain.

Note You might also need to adjust sound on the computer connected to the display. Refer to the computer manual for more information.

Routing Display Sound

To select how the sound is routed:

1. Click Routing (see Figure 31C).
2. Select a sound routing path (see Figure 32).

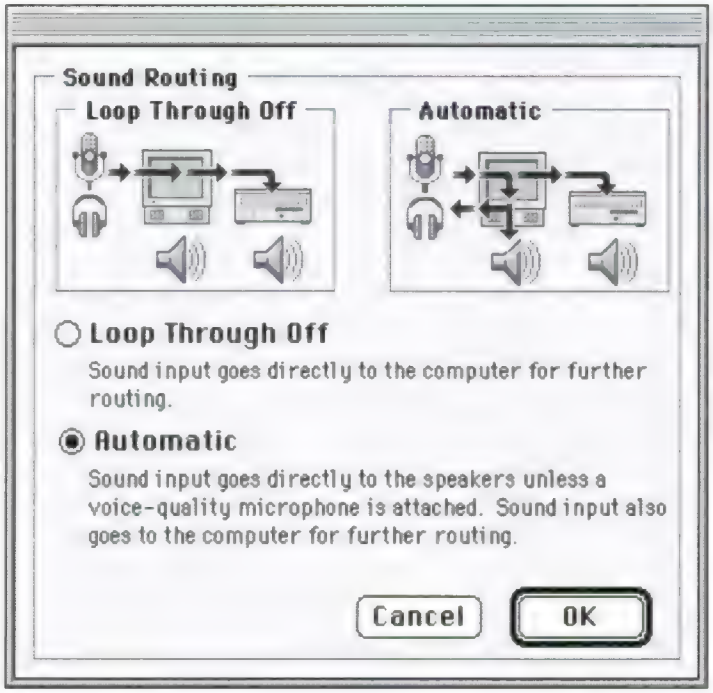


Figure 32. AudioVision Setup Sound Routing Path

3. Click
   - "Loop Through Off" (see Figure 32) if you're recording from a device and you don't want to hear the sound on your display
   - "Automatic" (see Figure 32) if you want sound routed to the speakers, headphones, and computer unless a voice-quality microphone is attached

Note A *voice-quality microphone* is any microphone that has an extended stereo miniplug connector.

4. Click OK (see Figure 32).

Adjusting Volume, Treble, and Bass.

1. Drag the Speaker Volume slider (see Figure 33) to adjust speaker volume.
2. If desired, adjust treble and bass by dragging these slider controls.
3. If desired, adjust headphone volume by dragging the slider control (see Figure 33) to the right to increase volume, or to the left to decrease volume.

Note

When you make volume adjustments, "Mute all sound" is turned off automatically. When you make speaker volume adjustments and headphones are attached to the display, "Mute speakers when headphones are attached" is turned off automatically.

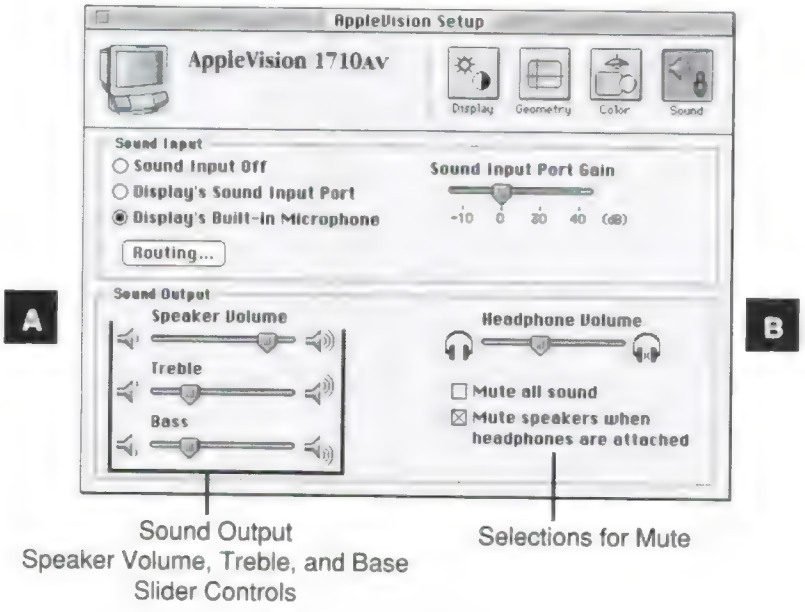


Figure 33. AudioVision Setup Sound

The Control Strip

The *control strip* (see Figure 34A) is a line of small icons that appears when you turn on the AppleVision display.

The control strip allows you to make quick and easy changes to common settings (such as screen resolution or color depth).

Using the Control Strip

Refer to Table 8 and Figure 34A to manipulate the control strip.

Table 8. Using the Control Strip

To...	Do this...
Close	Click close box or click tab
Open	Click tab
Resize	Click and drag tab
Move	Hold down Option key and drag tab
Hide	Press Shift-Control-C
Customize	Apple menu: Control Panels: Control Strip

Changing Screen Resolution

To view or change the display's screen resolution:

1. Move the pointer over the checkerboard screen icon (see Figure 34B), and depress the mouse button.
2. Select a screen resolution from the pop-up menu.

Note Figure 34B shows what you might see if two displays were connected to your computer

Changing Color Depth

To view or change the display's color depth:

1. Move the pointer over the striped screen icon (see Figure 34C), and depress the mouse button.
2. Select a color setting from the pop-up menu.

Note Figure 34C shows what you might see if two displays were connected to your computer.

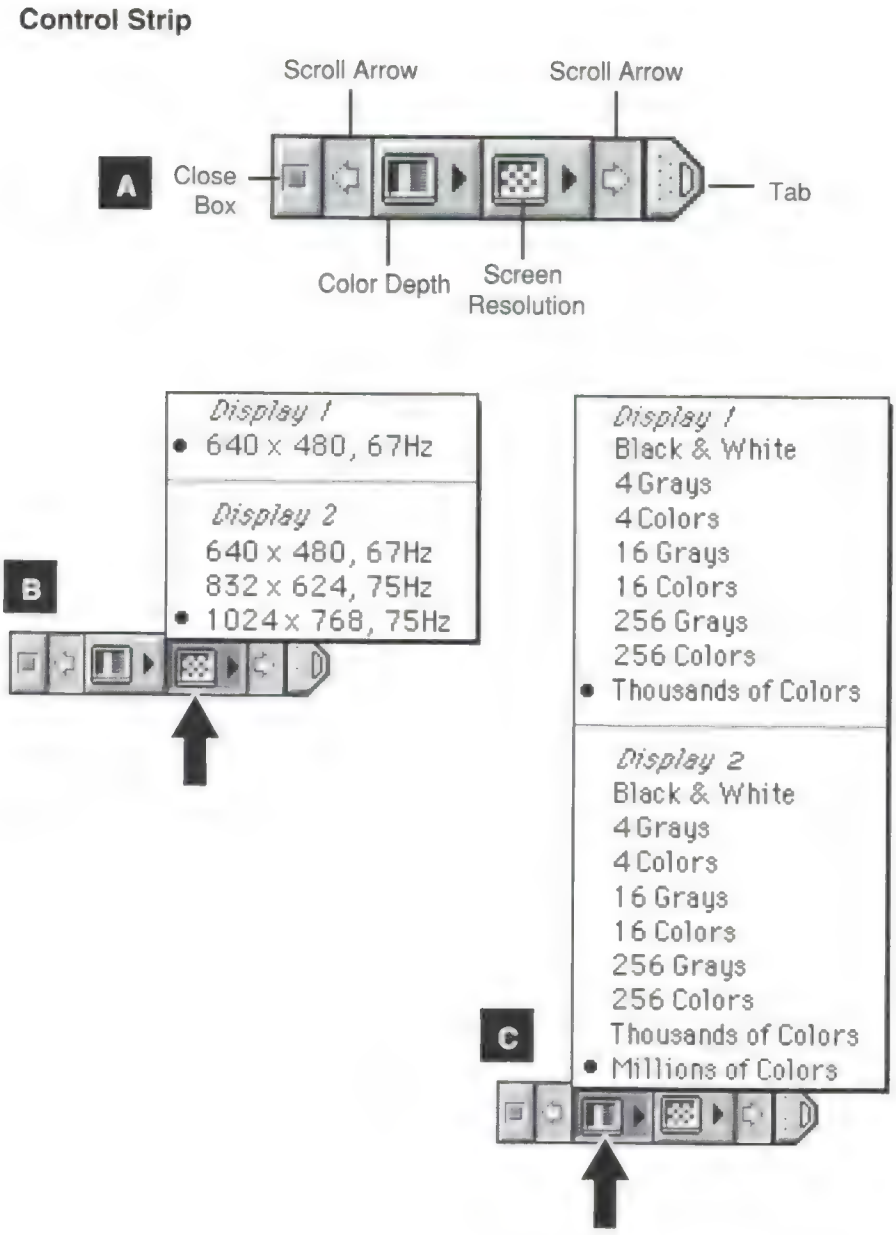


Figure 34. AudioVision Control Strip

Apple Multiple Scan 20

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Exploded View

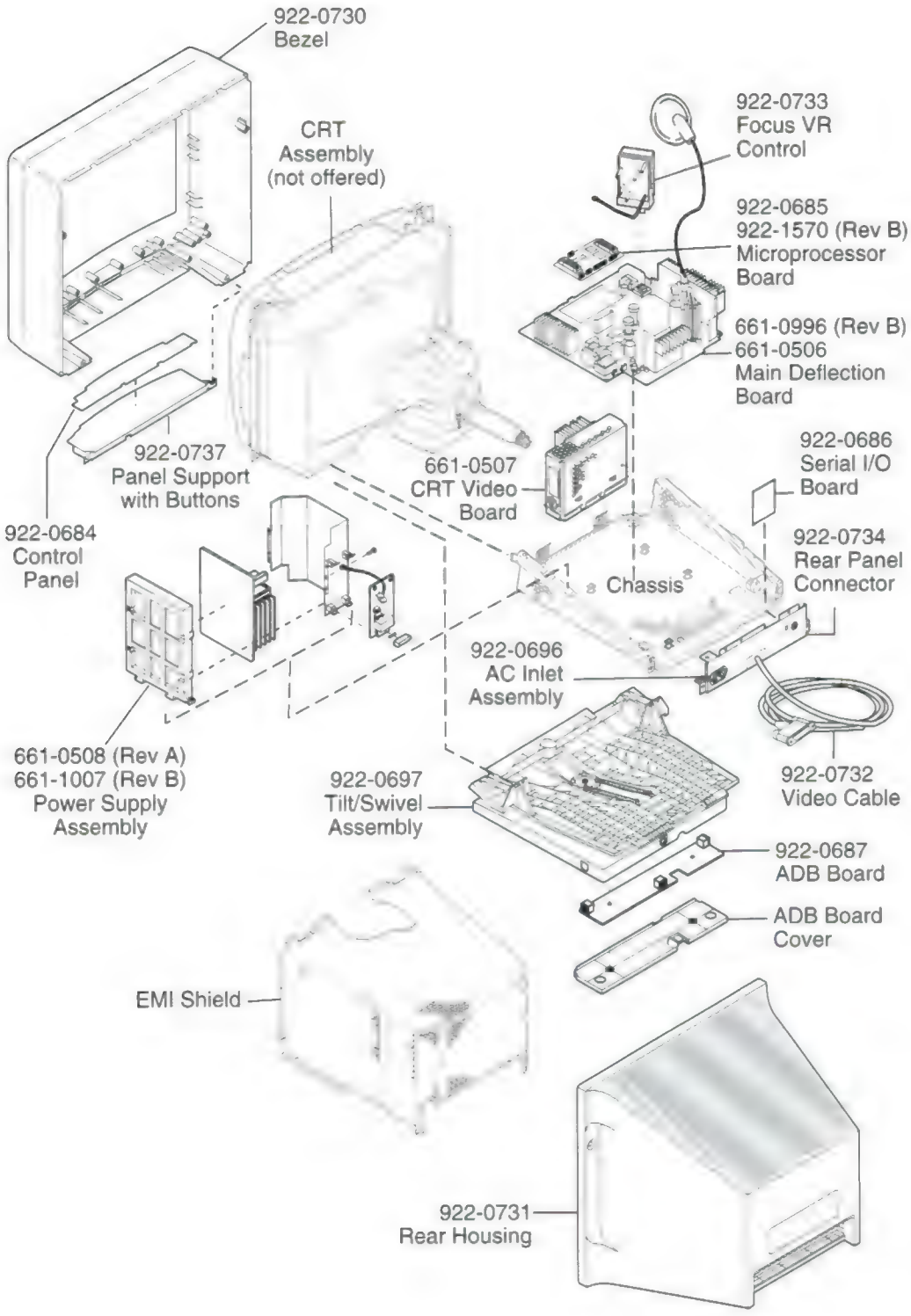


Figure 35. Apple Multiple Scan 20 Display & Rev B Exploded View

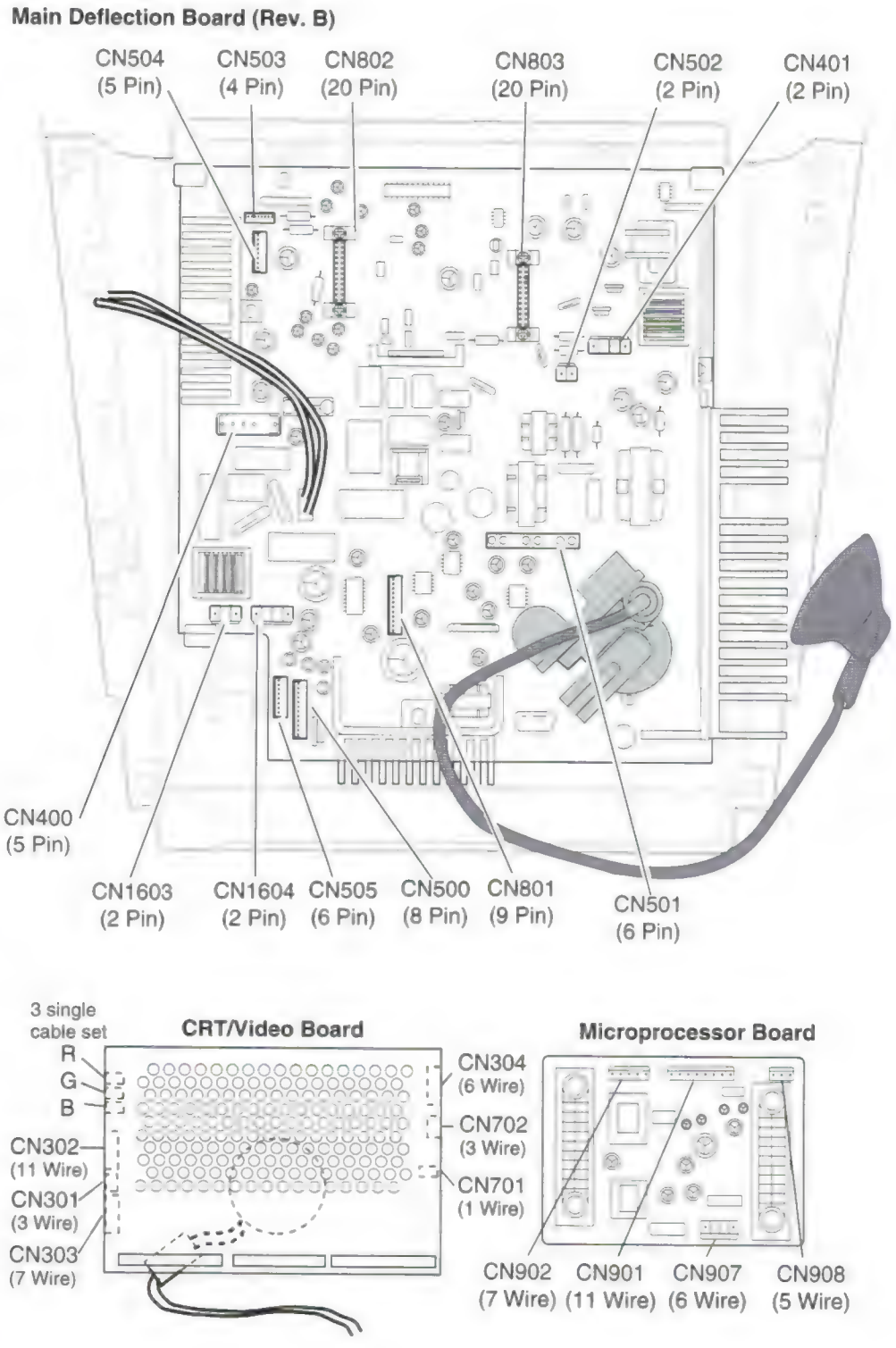


Figure 36. Multi Scan 20 Display & Rev B Main Circuit Boards

Parts List

AC Inlet	922-0696
Adapter, Mac/PC Display	922-0736
Bezel Assembly	922-0730
Board Assembly, Base ADB	922-0687
Board, CRT/Video	661-0507
Board, Main Deflection, Rev. B	661-0996
Board, Main Deflection	661-0506
Board, Microprocessor Control, Rev. B	922-1570
Board, Microprocessor Control	922-0685
Board, Serial I/O	922-0686
Cable, ADB, CPU/Tilt-Swivel Monitor Stand	590-4501
Cable, Video	922-0732
Control Panel Assembly	922-0684
Focus VR Control	922-0733
Fuse, 6.3 Amp, 250 V (Pkg. of 10)	922-0735
Housing, Rear	922-0731
Label, ID	825-2744
Panel, Rear, Connector	922-0734
Panel, Support w/Buttons	922-0737
Power Cord, AC, 110 V, Smoke	590-0373
Power Cord, AC, 220 V, Smoke	590-0423
Power Supply, Rev. B	661-1007
Power Supply	661-0508
Screw/Cable Kit	076-0227
Tilt/Swivel, Multi Scan 20 Display	922-0697

First Checklist

Important More than 60 percent of the Apple Multiple Scan 20 Display modules returned for repair are found to be fully operational. Read this checklist before you return a module. Prevent needless module replacement and unnecessary time delays. For additional information refer to "Environmental Display Distortions," in Chapter 1, "General Monitor Information."

- **The Apple Multiple Scan 20 Display is not fully compatible with all Macintosh computers and PowerBooks.**

If you suspect a loss of functionality, especially with the number of screen resolutions available (in Control Panels), check the Tech Info Library or contact Apple Technical Support.

- **The CRT video image will not always resemble a perfect rectangle.**

CRT tolerances allow for some distortion. Additional distortion can be caused by magnetized metal objects (desks, file cabinets, and so on). Move the unit to a different location if you notice video bowing or bent edges.

- **Jitter, faint lines, or screen movement can be caused by external interference such as electronic devices and fluorescent lights.**

Move the unit to another room or building to help determine if external interference is the source of the problem.

- **A misadjusted screen can mimic the symptoms of deflection board or CRT failures.**

By performing the adjustment procedures, you might determine if one or more of the adjustments is the cause of the problem.

- **CRTs rarely fail.**

Needless CRT replacements can be prevented by checking display adjustments, checking the possibility of other defective modules, and accepting small imperfections in screen display.

If you have any doubts about whether a CRT is defective, contact Apple Technical Support.

How to Distinguish Board Versions

The Apple Multiple Scan 20 Display and Apple Multiple Scan 20 Display Rev. B have the same overall appearance. However, the Rev. B version offers improved performance and better screen resolution.

To distinguish the two versions, check the last three digits of the serial number. The serial number for the Rev. B version ends in one of the following:

- 5B4
- 5J2
- 5JE
- 5JF

EEPROM Settings

Each Multiple Scan 20 monitor has an EEPROM (located on the microprocessor controller board) that contains adjustment information specific to that monitor. Before you replace the microprocessor board, save this EEPROM information.

▲ Caution **If the settings are lost before they can be written to the new EEPROM, the display will be impossible to repair, and the whole display must be replaced.**

Use Display Service Utility to preserve the monitor adjustment settings.

Connect the Hardware to Restore Settings

You can use one of two ways to connect the hardware to use the Display Service Utility:

1. Connect a serial cable (mini DIN-8) between the malfunctioning display and a separate computer running Display Service Utility. Use either the modem port or the printer port on the computer. (If you use the printer port, AppleTalk must be turned off). Also connect a power cable to the display.
   - **Advantage:** You do not have to shut down the host computer or quit Display Service Utility to complete the repair.
   - **Disadvantage:** This method requires a separate host computer (with display).
2. Connect the display as usual, using a video cable and power cable. Also, connect a serial cable (mini DIN-8) between the display and either the modem or printer port on the computer.

- **Advantage:** This method lends itself to on-site repair. The display under repair is the only display required.
- **Disadvantage:** Since the microprocessor board on the display needs to be replaced, the display may not be working well enough to view this utility. Also, after creating the data file from the old EEPROM, you must quit Display Service Utility and shut down the computer to install the new EEPROM.

Save the EEPROM Information

To save information from the old EEPROM, create a data file:

1. Start Display Service Utility
2. Choose"Apple Multiple Scan 20 Display."
3. Click "Create File."

Install the Microprocessor Board

After the new microprocessor board is installed, the new EEPROM will have default settings that allow you to read the display, but with difficulty. When the settings from the old EEPROM are transferred to the new EEPROM, the display should be clear and the last color temperature mode chosen should be restored. See "Restore the EEPROM Information" (next topic), to restore the saved EEPROM data file.

Refer to the Apple Multiple Scan 20 Display chapter, Take Apart, "Microprocessor Board", on *Service Source CD* for instructions on installing the new microprocessor board.

Restore the EEPROM Information

To download the saved adjustment information to the new EEPROM:

1. Start MacTest Pro Display Service Utility.
2. Choose "Apple Multiple Scan 20 Display."
3. Select "Test."
4. Click "Write File."

▲ Caution **Make certain that you are aware of the following important information about the EEPROM data file. If data is lost or corrupted, you must to return the display to Apple for repair.**

- Verify that data in the saved file is written back to the display used to create the file. Each display is unique, so writing the wrong data to a display may cause severe adjustment problems.
- Verify that the data file is deleted after writing the data back to the display. This erasure ensures that data from one display is not accidentally written to another.
- Do not delete the new data file before it's written to the new EEPROM. If the file is lost before the data can be written to the new EEPROM, the repair will be impossible to complete and the whole display must be returned.

Symptom/Cure Chart

Use the following symptom/cure chart as a troubleshooting guide. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see Chapter 1, "General Monitor Information."

For additional assistance, contact Apple Technical Support.

Video	Solutions
No video; power indicator light on	1. Ensure that monitor's video cable is properly connected to computer or to video card in the computer. 2. Replace main deflection board. 3. After downloading settings as described in "EEPROM Settings" in this chapter, replace microprocessor board.
Video image jumps	After downloading settings as described in "EEPROM Settings" in this chapter, replace microprocessor board.
Video image edges have color blotches when displaying an all-white screen	1. Degauss monitor with an external degaussing coil. 2. Move monitor to different location and repeat degaussing procedure.
Video distorted; no picture	1. After downloading settings as described in "EEPROM Settings" in this chapter, replace microprocessor board. 2. Replace main deflection board.

Power	Solutions
Monitor does not power up	1. Ensure that monitor's video cable is properly connected to computer or to video card in the computer, and check other cable connections. 2. Replace power supply.
Monitor shuts down	1. Ensure that monitor's video cable is properly connected to computer or to video card in the computer. 2. Replace main deflection board. 3. Replace CRT/video board.

Indicator Lights (see Figure 37)	Solutions
Convergence indicator light blinks or stays on; power indicator light might also blink	After downloading settings as described in "EEPROM Settings" in this chapter, replace microprocessor board.
Rotation indicator light blinks or stays on; power indicator light might also blink	Replace main deflection board.
Size indicator light blinks or stays on; power indicator light might also blink	1. Replace main deflection board. 2. Replace CRT/video board. 3. After downloading settings as described in "EEPROM Settings" in this chapter, replace microprocessor board.
Centering indicator light blinks or stays on; power indicator light might also blink	1. Replace main deflection board. 2. After downloading settings as described in "EEPROM Settings" in this chapter, replace microprocessor board.

Miscellaneous	Solutions
Picture dim; adjusting front panel controls does not increase brightness	1. Ensure that screen does not face a window or other source of ambient light. This type of environment gives screen a dim appearance. For information on environmental distortions, see Chapter 1, "General Monitor Information." 2. Replace CRT/video board.
Picture has vertical jitter	1. Move monitor to different location to see if symptom persists. **Note:** This symptom is often caused by electromagnetic interference (electronic devices, fluorescent lights, power lines, and so on). 2. Replace main deflection board.
Monitor emits snapping sound; video blinks for an instant	**Note:** This symptom, caused by foreign particles inside the CRT, normally occurs only in new monitors. If the symptom persists after 40 hours of operation, there is a hardware problem. 1. Replace power supply. 2. Check to see if arcing on main deflection board is the cause. If so, replace main deflection board. If not, CRT is defective.
Picture color uneven	Adjust rotation and color uniformity. Refer to "Geometry" in the "Adjustments" chapter.

Focus blurry on one side of screen.	1. Adjust focus. Refer to "Convergence" in the "Adjustments" chapter. 2. Replace main deflection board.
Upon first use, monitor screen shows cloth-like pattern of black, dark gray, or white fine vertical lines	1. Select the All White display pattern, and adjust size and rotation controls on the monitor's front panel. Aim for reducing the visibility of the lines while minimizing discoloration. 2. At startup, lightly tap the side of the monitor so that you see the display image move. After the display has warmed up for 30 minutes, tap the monitor again. 3. Replace monitor.

Wiring Information

Reference the following table and callout locations in Figure 36 when connecting and disconnecting video cables from the Main Deflection Boards, CRT/Video, and Microprocessor Board.

Table 9. Multiple Scan 20 Display Wiring Information

Cables	Connection from:	Connection to:
2-wire (blue & orange)	Main Deflection Board CN1603	"F" Board mounted on Power Supply CN1601
2-wire (blue & orange)	Main Deflection Board CN1604	Power Supply CN601
6-wire (5 gray, 1 white)	Main Deflection Board CN505	CRT/Video Board CN304 (via wire bundle)
8-wire (7 gray, 1 white)	Main Deflection Board CN500	Power Supply CN602 (via wire bundle)
2-wire (white & orange)	"F" Board (mounted to Power Supply) CN1600	AC Power outlet
5-wire (4 gray, 1 red)	Serial I/O Board CN250	Main Deflection Board CN908
3-wire (white, black, red-pin1)	Serial I/O Board CN254	CRT/Video Board CN301
3-wire (yellow, black, white-pin1)	Serial I/O Board CN253	Video Cable (wrapped w/RGB cables)
11-wire (10 gray, 1 white)	CRT/Video Board CN302	Main Deflection Board CN901
7-wire (6 gray, 1 yellow)	CRT/Video Board CN303	Main Deflection Board CN902
3-wire (red, blue, green)	Video Cable	CRT/Video Board (blue closest to top of CRT/Video Board, red closest to center of board, green in the middle)
2-wire (gray & white)	Power Supply CN604	CRT/Video Board CN701 (via wire bundle)
5-wire (4 gray, 1 white)	Power Supply CN603	Main Deflection Board CN504
1-wire (black)	CRT/Video Board CN702	Main Deflection Board CN502
2-wire (both red)	CRT copper coil	Connector marked "NTC" to two wires (orange & yellow) to Main Deflection Board CN503 (4-wire)
2-wire (black & white)	CRT	Connector with two wires (dark orange & brown) to Main Deflection Board CN503 (4-wire) via wire bundle with 2-wires; orange & yellow)

Table 9. Multiple Scan 20 Display Wiring Information (Continued)		
Cables	**Connection from:**	**Connection to:**
6-wire (white, pin 1... blue, pin 6)	Microprocessor Control Board CN907	Front Panels
2-wire (both black)	Main Deflection Board CN1605	Black wrapped wires at base of CRT
5-wire (brown, pin 1,...black, pin 5)	Main Deflection Board CN400	Neck of CRT
6-wire (red...white)	Main Deflection Board CN501	Neck of CRT
1-wire (black)	"F" Board mounted on Power Supply CN1602	Top screw that holds the power supply bracket to the metal cage of Main Deflection Board
2-wire (red & black)	Main Deflection Board CN401	Focus box Red- VIDF Black- HIDF
2-wire (red & black)	CRT/Video Board (bottom of board)	Focus box Red- FV2 Black- FV1
1-wire (black)	Flyback transformer	Focus box (MV)

Brightness and Contrast

Adjustment controls are located on the front panel.

1. Press the plus ("+") button to increase the brightness or contrast (see Figure 37).
2. Press the minus ("–") button to decrease the brightness or contrast (see Figure 37).

Geometry

Adjustment controls are located on the front panel.

Horizontal and Vertical Center

1. Press the select button (marked with "⌘") to turn on the centering indicator light (see Figure 37).
2. Press the plus ("+") or minus ("–") button on the brightness controls to move the center of the picture up or down, or the contrast controls to move the center of the picture right or left (see Figure 37).

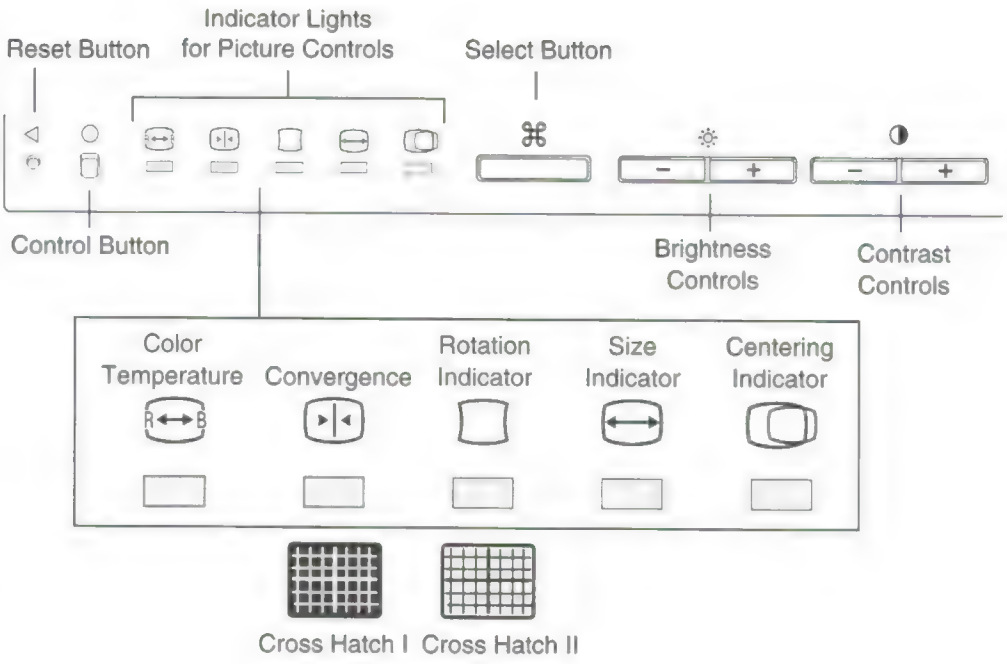
Horizontal and Vertical Size

1. Press the select button (marked with "⌘") repeatedly until the size indicator light goes on.
2. Press the plus ("+") or minus ("–") button on the brightness controls (for vertical size) or contrast controls (for horizontal size) to increase or decrease the size of the picture (see Figure 37).

Rotation and Color Uniformity

1. Press the select button (marked with "⌘") repeatedly until the rotation indicator light goes on (see Figure 37).
2. Press the plus ("+") button on the brightness controls to tilt the picture clockwise.
3. Press the minus ("–") button on the brightness controls to tilt the picture counterclockwise.

Note When the picture rotates, the color uniformity also changes. Rotating the picture clockwise causes colors to darken on the lower-right of the screen. Rotating the picture counterclockwise causes colors to darken on the lower left. When rotation and color uniformity are set properly, the picture is rectangular and all four corners of the picture have consistent color.



• WARNING •

Serious Injury could result if, with the power on, you touch any of the high-voltage area shown below. Review the CRT safety rules before performing adjustments.

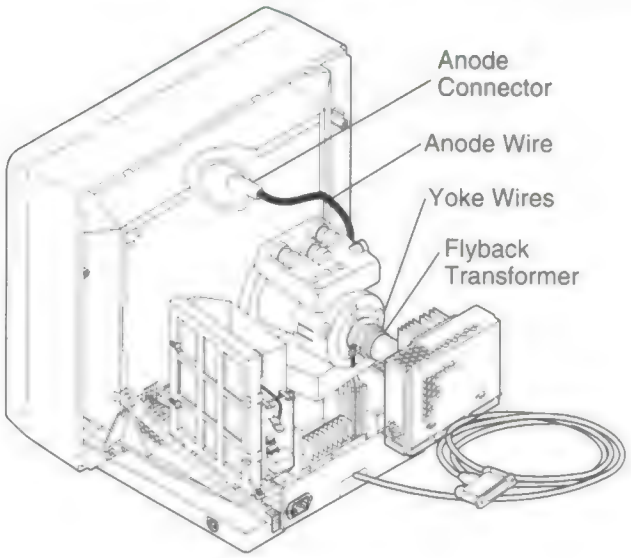


Figure 37. Apple Multiple Scan 20 Adjustments

Shape

1. Press the select button (marked with "⌘") repeatedly until the rotation indicator light goes on (see Figure 37).
2. Press the plus ("+") button on the contrast controls to expand the sides of the picture.
3. Press the minus ("–") button on the contrast controls to bring in the sides of the picture.

Convergence

Adjustment controls are located on the front panel. When the convergence is set properly, the picture is crisp and clear.

Vertical Convergence

1. Press the select button (marked with "⌘") repeatedly until the convergence indicator light goes on (see Figure 37).
2. Press the plus ("+") button on the brightness controls to move the red signal up and the blue signal down.
3. Press the minus ("–") button on the brightness controls to move the red signal down and the blue signal up.

Horizontal Convergence

1. Press the select button (marked with "⌘") repeatedly until the convergence indicator light goes on (see Figure 37).
2. Press the plus ("+") button on the contrast controls to move the red signal to the right and the blue signal to the left.
3. Press the minus ("–") button on the contrast controls to move the red signal to the left and the blue signal to the right.

Color Temperature

Color temperature refers to the intensity of the red/green/blue signals sent to the monitor. The color temperature settings are

- 9300 K: white appears bluish (default)
- 6500 K: white appears page white
- 5000 K: white appears reddish

Color temperature can be changed to accommodate preference or application specifications. Adjustment controls are located on the front panel.

1. Press the select button (marked with "⌘") repeatedly until the color temperature indicator light (see Figure 37) goes on.

Note The indicator may or may not blink, depending on the color temperature selected. A steady light indicates 9300 K, a slow-blinking light indicates 6500 K, and a fast-blinking light indicates 5000 K.

2. Press the plus ("+") button on the contrast controls to increase the color temperature (see Figure 37).
3. Press the minus ("–") button on the contrast controls to decrease the color temperature (see Figure 37).

Factory Settings

Important The monitor controls are set at the factory. To fine-tune and adjust the picture, use the front panel controls. The monitor will use your settings each time the computer is turned on. Use the recall function to return to factory settings.

Recall

You can reset brightness and contrast to their factory levels. However, you cannot reset one or the other. You must reset both controls. Use a straightened paper clip to push in the Reset button (see Figure 37).

Reset a Specific Control

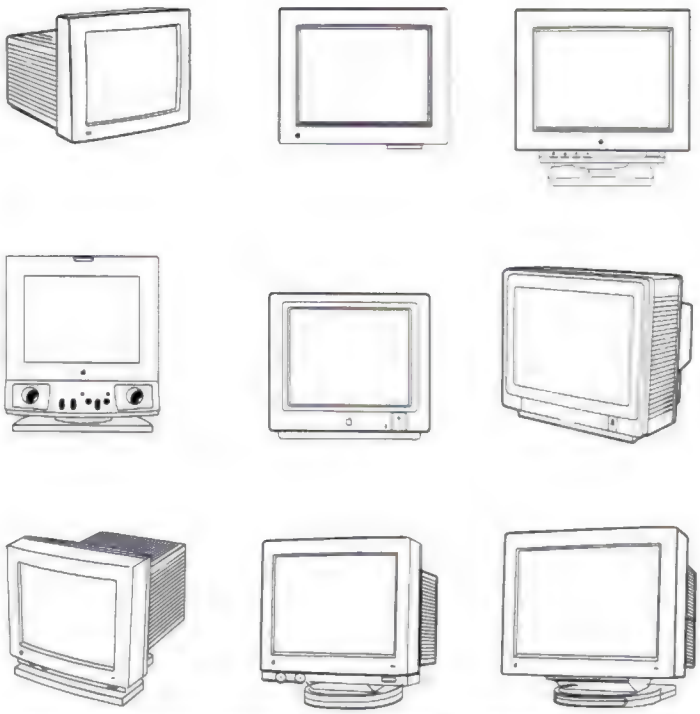
1. Press the select button (marked with "⌘") repeatedly until the indicator light of the picture control you want to reset (vertical or horizontal center, convergence, or color temperature) goes on (see Figure 37).
2. Use a straightened paper clip to push in the Reset button. The selected picture control is reset to its original level.

Reset all Controls

While holding down the control button, push in the Reset button with a straightened paper clip.

All picture controls are reset to their factory levels.

Color Displays



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Macintosh 12" RGB Display

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Exploded View

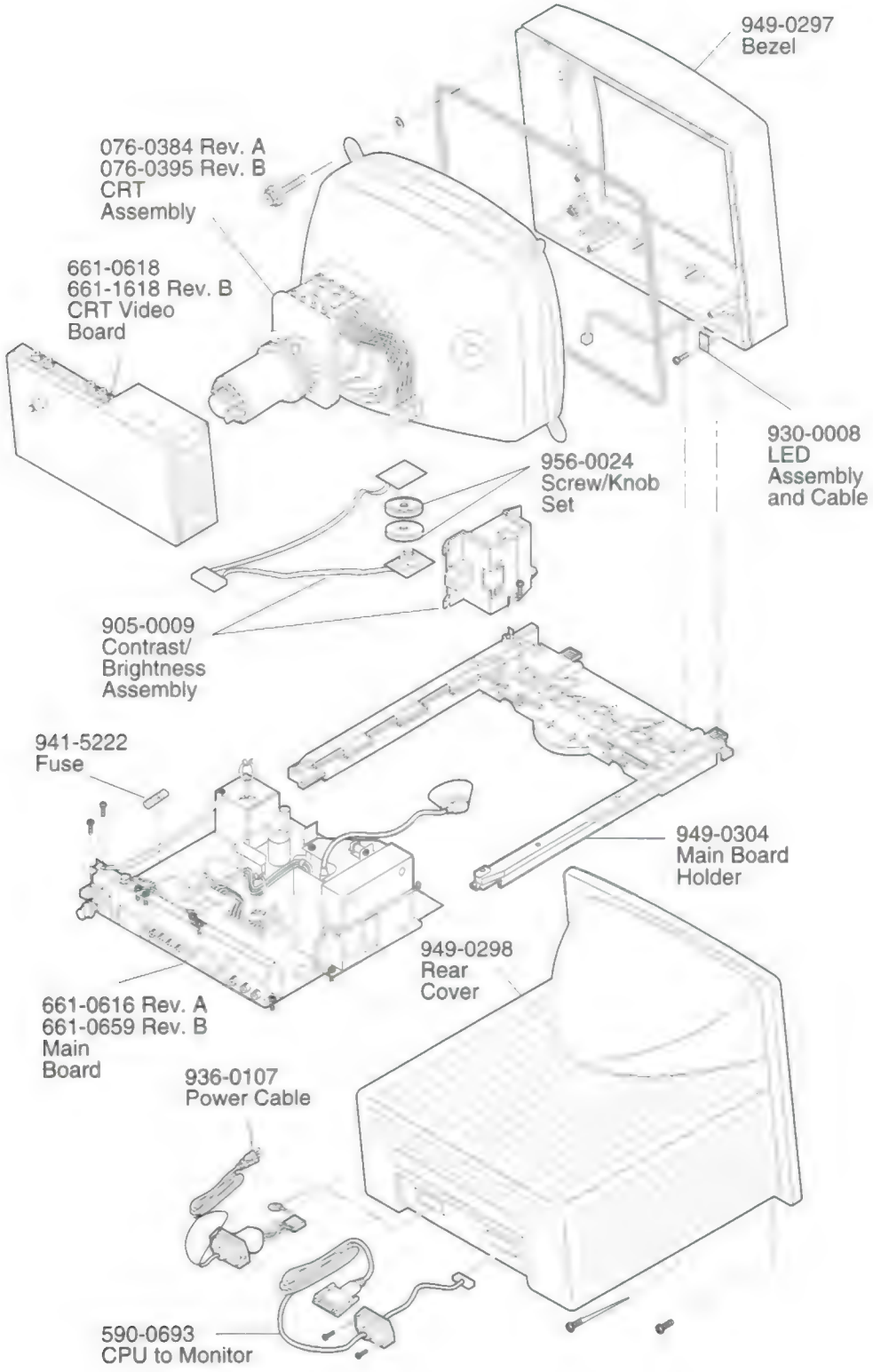


Figure 38. Macintosh 12" RGB Display Exploded View

Main Circuit Boards

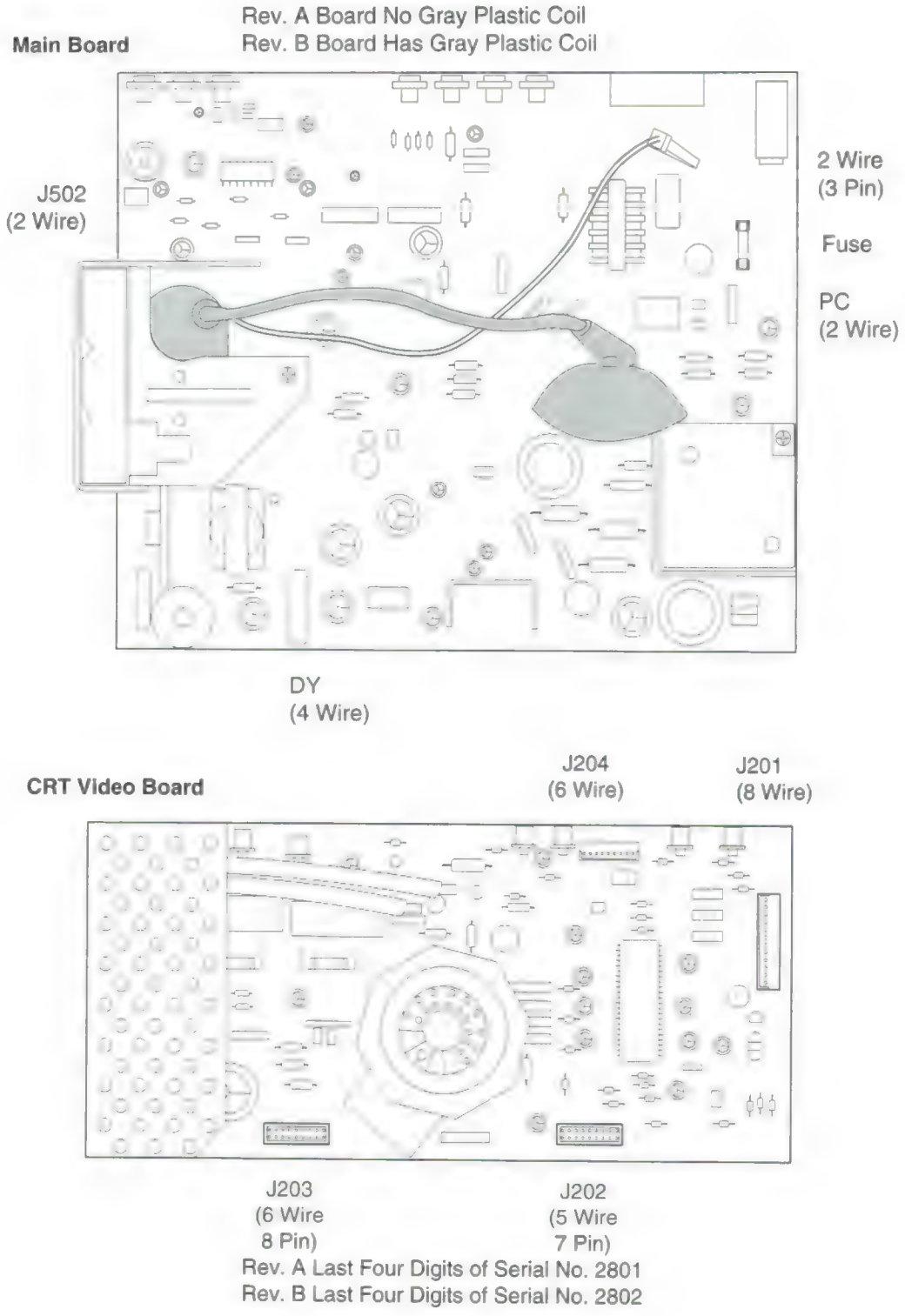


Figure 39. Macintosh 12" RGB Main Circuit Boards

Parts List

Bezel, Plastic Case	949-0297
Cable, CPU to Monitor, Macintosh 12" RGB	590-0693
Cable, Power, European (1 M)	590-0420
Contrast/Brightness Assembly	905-0009
CRT Assembly, Rev. A	076-0384
CRT Assembly, Rev. B	076-0395
CRT Video Board, Rev. B[1]	661-1618
CRT Video Board	661-0618
Facilitation Warranty Reimbursement, Per Repair	011-0083
Fuse, 125V 3.15A	941-5222
High Voltage Probe	076-0392
LED Assembly with Cable	930-0008
Main Board Holder, Plastic	949-0304
Main Deflection Board, Rev. A[2]	661-0616
Main Deflection Board, Rev. B[3]	661-0659
Power Cable, 120 V (1M) Captive	936-0107
Rear Cover, Plastic (International)	949-0303
Rear Cover, Plastic, Macintosh 12" RGB Monitor	949-0298
Screw/Knob Set	956-0024

1. The universal video board can be identified by reading the 11-digit serial number on the lower edge of the board. The last four digits are 2802.
2. Order the Rev. A Main Deflection board if (1) your board does *not* have a gray plastic coil (VR504) next to connector J502 and (2) your CRT is the standard CRT, Apple P/N 0776-0384.
3. Order the Rev. B Main deflection board if (1) your board has a gray plastic coil (VR504) next to connector J502 and (2) your CRT is the Low ELF CRT, Apple P/N 076-0385.

Troubleshooting

Symptom/Cure Chart

Use the following symptom/cure chart as a troubleshooting guide. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement.

For additional assistance, contact Apple Technical Support.

No Video	Solutions
No video, LED off	1. Ensure that monitor's video cable is connected to computer or to video card in the computer. 2. Check power cord. 3. Check internal power connectors. 4. Replace blown fuse. 5. Replace external power cable assembly. 6. Replace main deflection board.
No video, LED on	1. Ensure that monitor's video cable is connected to computer or to video card in the computer. 2. Adjust contrast and brightness user controls. 3. Verify that video card in monitor is working properly. 4. Check main deflection board and CRT/video board connectors. 5. Replace blown fuse. 6. Perform screen adjustment. 7. Replace main deflection board. 8. Replace CRT/video board. 9. Replace CRT.

Geometry	Solutions
Video image size short/tall, narrow/wide	1. Adjust V-HEIGHT or H-WIDTH controls on main deflection board. 2. Replace main deflection board. 3. Replace CRT.
Video image not centered	1. Verify that distortion is not caused by environmental conditions. Move monitor to another location. 2. Adjust H-CENT or V-CENT external controls. 3. Replace main deflection board.
Horizontal linearity bad (screen sides differ)	Replace main deflection board.

Vertical linearity bad (screen top and bottom differ)	1. Adjust V-LIN control on main deflection board. 2. Replace main deflection board.
Video image bows	1. Verify that distortion is not caused by environmental conditions. Move monitor to another location. 2. Check V-HEIGHT and V-CENT adjustment controls and H-WIDTH and H-CENT controls. (Some bowing from environmental conditions is normal and is within manufacturing tolerances. Slight bowing does not impair functionality of monitor.) 3. Replace main deflection board. 4. Replace CRT.
Entire video image is tilted	1. Verify that distortion is not caused by environmental conditions. Move monitor to another location. 2. Adjust yoke assembly as follows: a. Switch off power and remove rear cover b. Loosen frontmost screw on neck of CRT c. Twist yoke assembly as appropriate d. Retighten screw on neck of CRT (Do not over-tighten screw; you could break neck of CRT.) 3. Switch on monitor and check display 4. Replace main deflection board.
Abnormal/distorted video image (other than above)	1. Verify that distortion is not caused by environmental conditions. Move monitor to another location. 2. Check all cable connections. 3. Perform geometric adjustments. 4. Replace main deflection board. 5. Replace CRT/video board. 6. Replace CRT.

Synchronization	**Solutions**
Picture breaks into diagonal lines	1. Connect another monitor to computer and verify video signal. 2. Adjust H-HOLD control on main deflection board. 3. Replace main deflection board.
Picture rolls vertically	1. Verify that video card in monitor is working properly. 2. Adjust V-HOLD control on main deflection board. 3. Replace main deflection board.
Single vertical or horizontal line on screen	1. Check yoke connector (DY). 2. Replace main deflection board. 3. Replace CRT.

Video	Solutions
Predominant red, blue, or green tint	1. Check video cable connection. 2. Verify that video card in monitor is working properly. 3. Perform White Balance adjustments. 4. Replace CRT/video board. 5. Replace CRT.
Picture too dark or too bright	1. Adjust contrast and brightness knobs. 2. Verify that video card in monitor is working properly. 3. Perform video adjustments (Cutoff and White Balance). 4. Replace main deflection board. 5. Replace CRT/video board. 6. Replace CRT.
Cannot adjust brightness, contrast, or color	1. Replace contrast/brightness assembly. 2. Replace main deflection board. 3. Replace CRT/video board.
Out of focus	1. Adjust focus control on flyback transformer. 2. Perform screen adjustment. 3. Replace main deflection board. 4. Replace CRT.

Miscellaneous	Solutions
Intermittently shuts down	1. Ensure that monitor's video cable is connected to computer or to video card in the computer. 2. Replace main deflection board.
Picture jitters or flashes	1. Check that ground cables are secure. 2. Check that adjacent computer equipment is properly grounded. Move other electrical devices away from monitor. Shut off fluorescent lights. 3. Replace main deflection board.
Flashing or wavy screen	1. Crimp metal connector tabs on video connector. 2. Replace main deflection board.
Black spots on screen (burnt phosphors)	Replace CRT.

Screen Voltage Procedure

▲ Warning **This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review the CRT safety rules in Chapter 1, "General Monitor Information."**

Note If you have replaced the main deflection board, you must perform the screen adjustments prior to performing other adjustments. If you have not replaced the main deflection board, go to the "Geometry" adjustments.

Note Perform the screen voltage adjustment only if one or more of the following conditions apply:

- You have replaced the main deflection board.
- You have inadvertently altered the screen adjustment.
- You have replaced the CRT/yoke assembly with a different revision CRT/yoke assembly.

Performing the screen voltage adjustment requires a voltmeter and a high-voltage probe (see Figure 40).

▲ Caution **Using a high-voltage probe other than Apple part number 076-0392 could damage the monitor. Use only a high-voltage probe that meets these specifications:**

- 40 KV (V DC) rating
- Input impedance of 1,000 megohms
- Banana clips to plug into a voltmeter
- Alligator clip to connect to ground

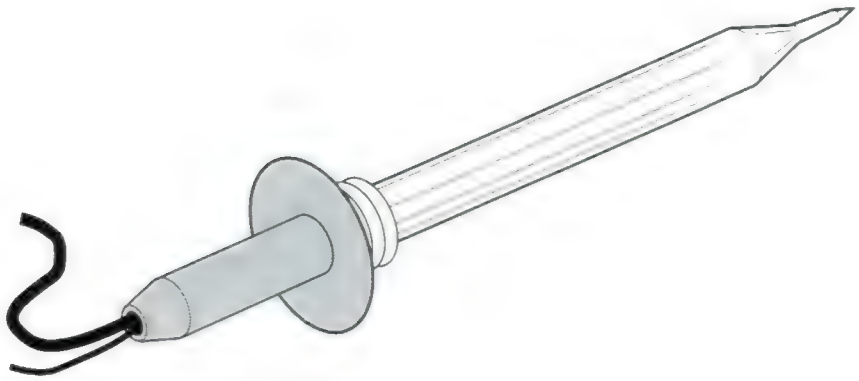


Figure 40. High-Voltage Probe

1. Switch on the voltmeter power and set the voltmeter to the 2 VDC (or lowest) setting.
2. Connect the high-voltage probe two-pronged connector to the ground and voltage receptacles on the voltmeter. Verify that the prong with the ground tab is in the ground receptacle.
3. Switch on the monitor and let it warm up for at least 10 minutes.
4. Attach the ground clip from the high-voltage probe to the metal chassis.
5. Set the contrast knob to maximum and the brightness knob to the center (detent) position (see adjustment foldout, Figure 43A).
6. Use Display Service Utility to display the Full Black Screen test pattern.
7. Turn the SUB-BRIGHT control (VR202) counterclockwise all the way down (see adjustment foldout, Figure 43B).
8. To set the screen voltage, first check the label (see Figure 41) on the side of the CRT to determine the type:
   - CRT type AT12A9SL
   - CRT type M29JMN097X13.

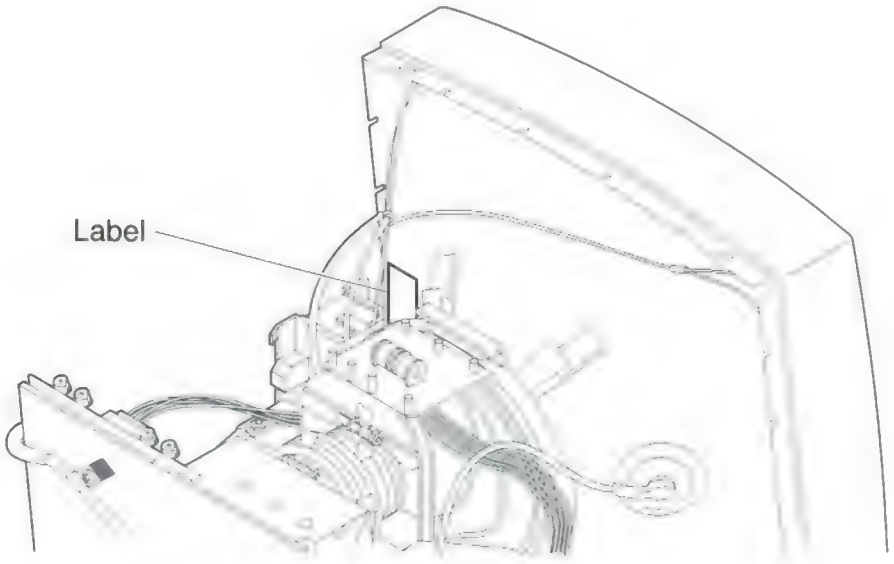


Figure 41. Determining the Type of CRT

▲ Warning **Because you must measure voltages in excess of 500 V DC, make sure the high-voltage probe is grounded to the metal monitor chassis. Do not short the probe between the test point and adjacent components.**

9. Touch the high-voltage probe to the voltage test point (see Figure 42) labeled SCREEN (U.S. version) or PIN 4 (international version). Adjust the screen control until the voltmeter reads:
   - 500 V (± .005 V) for CRT AT12A9SLB
   - 400 V (± .004 V) for CRT M29JMN097X13

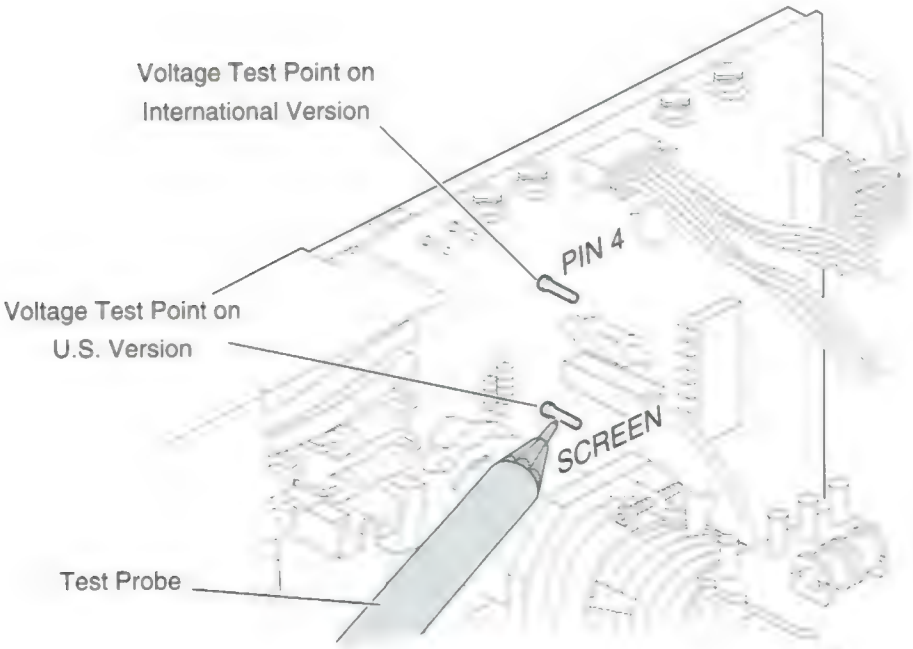


Figure 42. Voltage Test Points

10. Disconnect the high-voltage probe from the monitor.
11. Press the space bar or click the mouse to advance to the next test pattern. Turn the SUB-BRIGHT control (VR202) until the raster is visible.
12. Use Display Service Utility to display the Gray Bars test pattern.
13. Adjust the SUB-BRIGHT control until the first bar is black and the second bar is barely visible.
14. Using Display Service Utility, display the All-White Screen test pattern.

Note Each light meter model has specific meter readings. Note which model you are using before making adjustments. Refer to the "Light Meters" section in Chapter 1, "General Monitor Information," for more information.

15. Using the light meter and a two-inch plastic screwdriver, adjust the SUB-CONTRAST control (see Figure 43B) VR201 until you get the following:
    - Model L-248: top of the 10 scale
    - Model 246: 30 ft. lamberts (± 3 ft. lamberts)

Note If you are unable to adjust the SUB-CONTRAST control to get the correct reading, perform the White Balance video adjustment.

Geometry

▲ Warning **This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review the CRT safety rules in Chapter 1 "General Monitor Information."**

Note
- Reference the "Video Adjustments Foldout," Figure 43, when performing all video adjustments. Unfold Figure 43 so that the graphic is visible while making adjustments.
- Geometry adjustments may be necessary whenever you replace the main deflection board, CRT, or video board.
- Do not attempt yoke adjustments on this monitor. The factory settings require no adjustment.

Vertical Size

Vertical size, vertical center, and horizontal center adjustments can be performed without removing the rear cover.

1. Use Display Service Utility to display the All-White Screen test pattern.
2. Adjust the V-HEIGHT control (VR404) with a plastic screwdriver until the video image height is 153 mm (± 2 mm) or 6 1/16 in. (± 1/16 in.) (see Figure 43B).

Vertical Center

1. Using a plastic screwdriver, adjust the V-CENT control (VR403) until the video image is centered (top to bottom) in the display area (see Figure 43B).
2. Verify that the video image height is 6 1/16 in. (± 1/16 in.) or 153 mm (± 2 mm). If it is not, repeat the vertical size adjustment and, if necessary, the vertical center adjustment.

Horizontal Center

Using the plastic screwdriver, adjust the H-CENT control (VR503) until the video image is centered (side to side) in the display area (see Figure 43B).

If you cannot center the video image, set the H-CENT control at midrange and perform the following steps:

1. Switch off the monitor and remove the rear cover.
2. Switch on the monitor.
3. Using the plastic screwdriver, adjust the H-PHASE control (VR501) until the video image is positioned at the visual midpoint of the range of the H-PHASE control (see Figure 43B).
4. Using the plastic screwdriver, adjust the H-CENT control (VR503) (see Figure 43B) until the video image is in the approximate center of the screen.

Horizontal Size

Using the hex-head insulated adjustment tool, adjust the H-WIDTH control (L501) until the video image is 205 mm (± 2 mm) or 8 3/32 in. (± 1/16 in.) wide (see Figure 43B).

Vertical Linearity

1. Use Display Service Utility to display the Crosshatch I test pattern.
2. Using a plastic screwdriver, adjust the V-LIN control (see Figure 43B) until the distance between the horizontal lines is the same at the top and bottom of the screen.

Vertical Hold

1. Use Display Service Utility to display the All-White Screen test pattern.
2. Using a plastic screwdriver, adjust the V-HOLD control (VR401) (see Figure 43B) until the video image stabilizes. To check the adjustment, switch the monitor off and on. If the video image stabilizes immediately, V-HOLD is correctly set.

Horizontal Hold

Using the plastic screwdriver, adjust the H-HOLD control (VR502) (see Figure 43B) until the video image stabilizes. To check the adjustment, switch the monitor off and on. If the raster stabilizes immediately, H-HOLD is correctly set.

Focus

1. Use Display Service Utility to display the Focus test pattern.
2. Using a plastic screwdriver, adjust the FOCUS control (see Figure 43B) until the Focus test pattern is as clear as possible.

Video

▲ Warning **This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review the CRT safety rules in Chapter 1 "General Monitor Information."**

Perform video adjustments only if the color quality is unacceptable.

White Balance

Note Complete any necessary geometry adjustments before performing the White Balance adjustments.

1. Turn on monitor power and let the monitor warm up for at least 10 minutes.
2. Use Display Service Utility to display the Full Black Screen.
3. Set the brightness control and the contrast control (see Figure 43A) to maximum.
4. Preset these adjustment controls (see Figure 43B):
   - GREEN, RED, and BLUE CUT-OFF controls to minimum.
   - DRIVE-RED and DRIVE-BLUE controls to midrange.
   - SUB-CONTRAST control (VR201) to midrange.

5. Adjust the SUB-BRIGHT control (VR202) until you cannot see the raster, then turn up the SUB-BRIGHT control (see Figure 43B) until the raster is visible.
6. Adjust the GREEN CUT-OFF control (see Figure 43B) until green is the predominant color. The screen should be dark, but with an obvious green tint.
7. Use Display Service Utility to display the Gray Bars test pattern.
8. Set the brightness knob to the center (detent) position.
9. Alternately adjust the RED and BLUE CUT-OFF controls (see Figure 43B) until no predominant color appears in the left three bars.

Note If the SUB-BRIGHT control cannot be set properly, repair the monitor. Check that the leftmost bar is black. If not, turn the SUB-BRIGHT control counterclockwise until the leftmost bar is as black as the screen border.

10. If no predominant color appears in the right gray bars, set screen luminance (see the following procedure).
11. If you see a predominant color in the right three bars, alternately adjust the DRIVE-RED and DRIVE-BLUE controls until you see no predominant color in the bars.
12. If a predominant color now appears in the left three bars, repeat the White Balance adjustment.

Screen Luminance

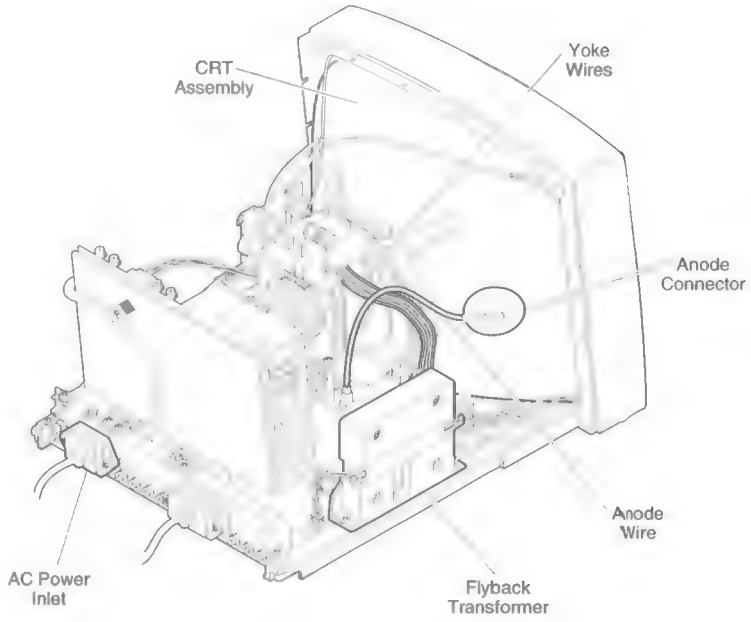
1. Using Display Service Utility, display the All-White Screen.

Note Each light meter model has specific meter readings. Note which model you are using before making adjustments. Refer to the "Light Meters" section in Chapter 1, "General Monitor Information," for more information.

2. Using the light meter and a two-inch plastic screwdriver, adjust the SUB-CONTRAST control (VR201) (see Figure 43B) until you get 30 foot lamberts (± 3 foot lamberts), which on the light meter is
   - Model L-248: middle of the 10 scale
   - Model 246: 23 on the red scale

• WARNING •

Serious Injury could result if, with the power on, you touch any of the high-voltage area shown below. Review the CRT safety rules before preforming adjustments.



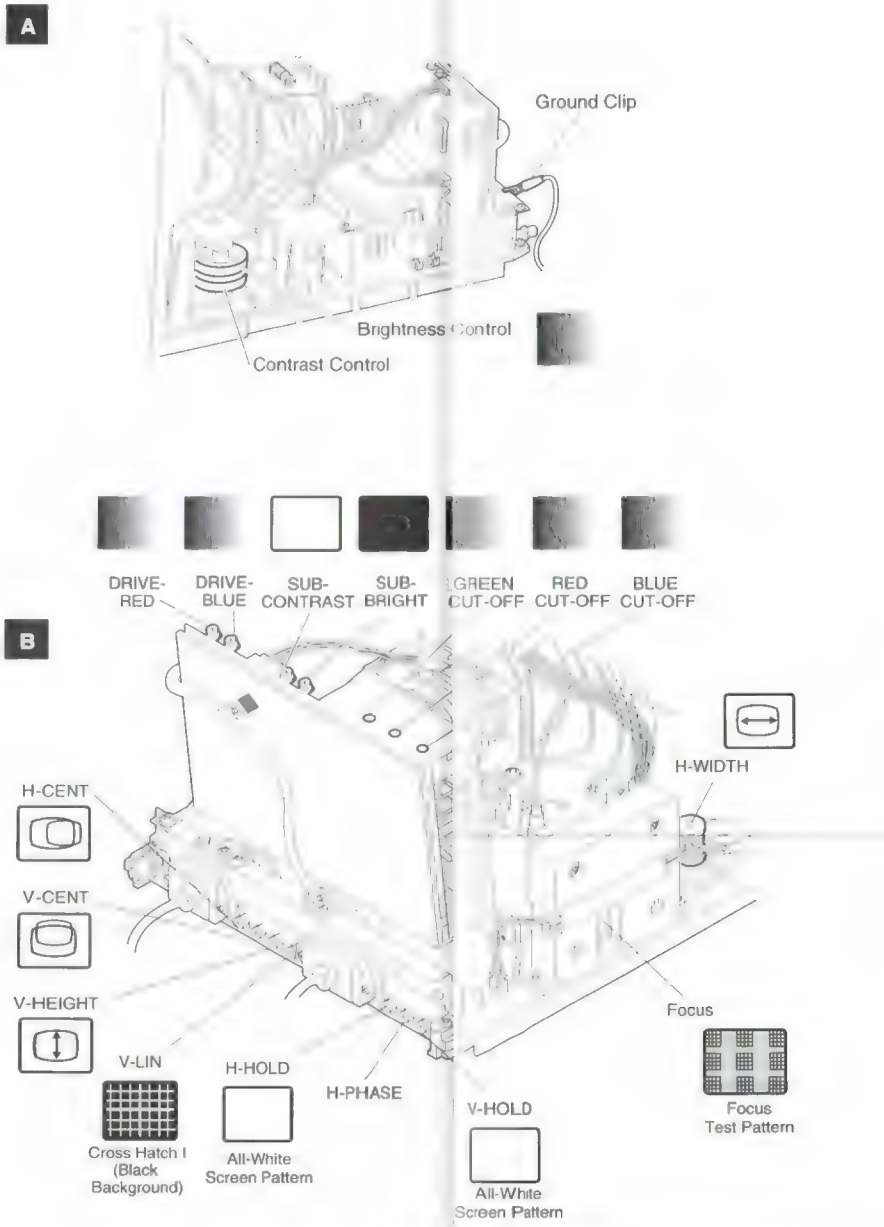


Figure 43. Macintosh 12" RGB Display Adjustments

Apple Color High-Resolution RGB Monitor

9

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Exploded View

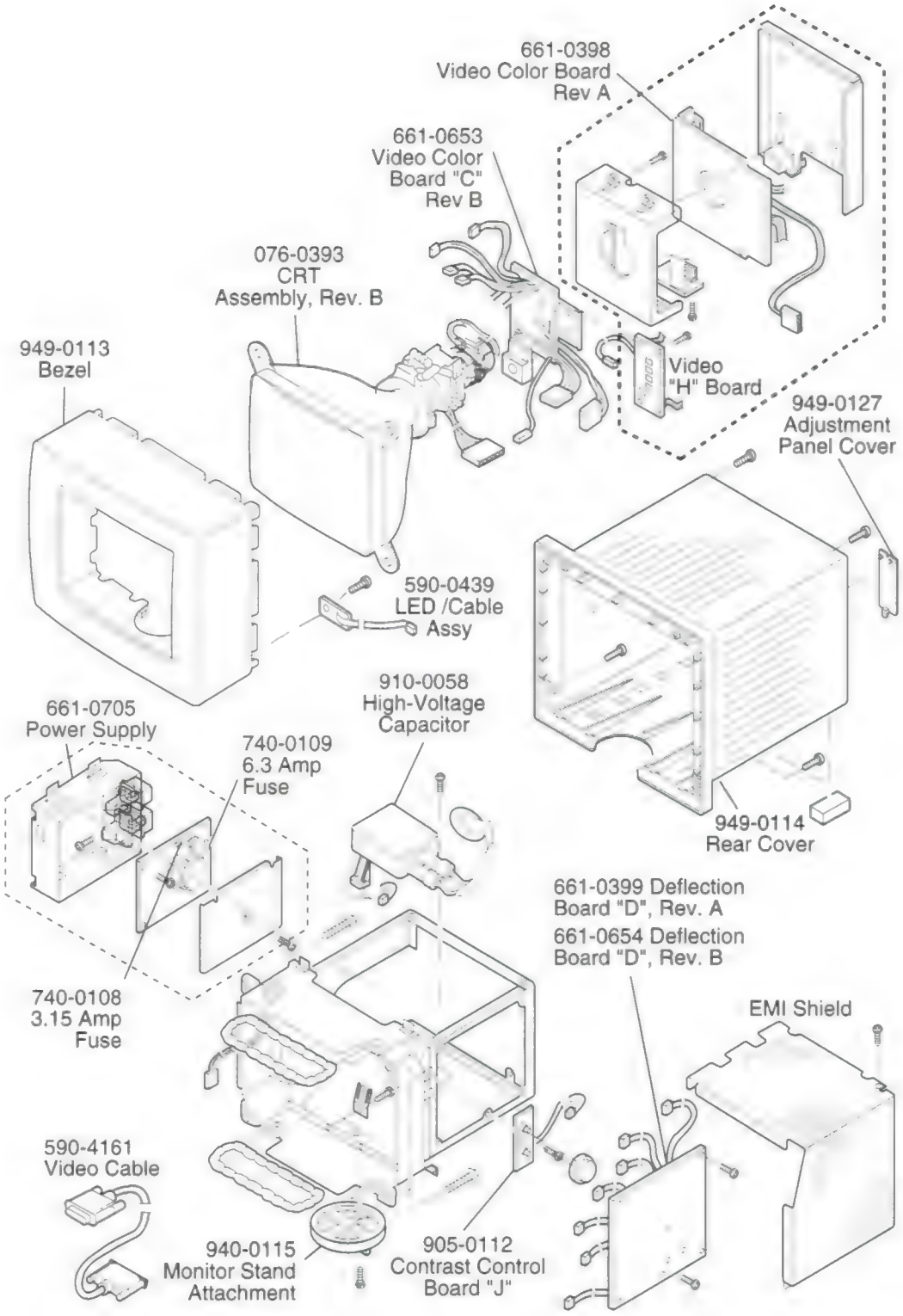
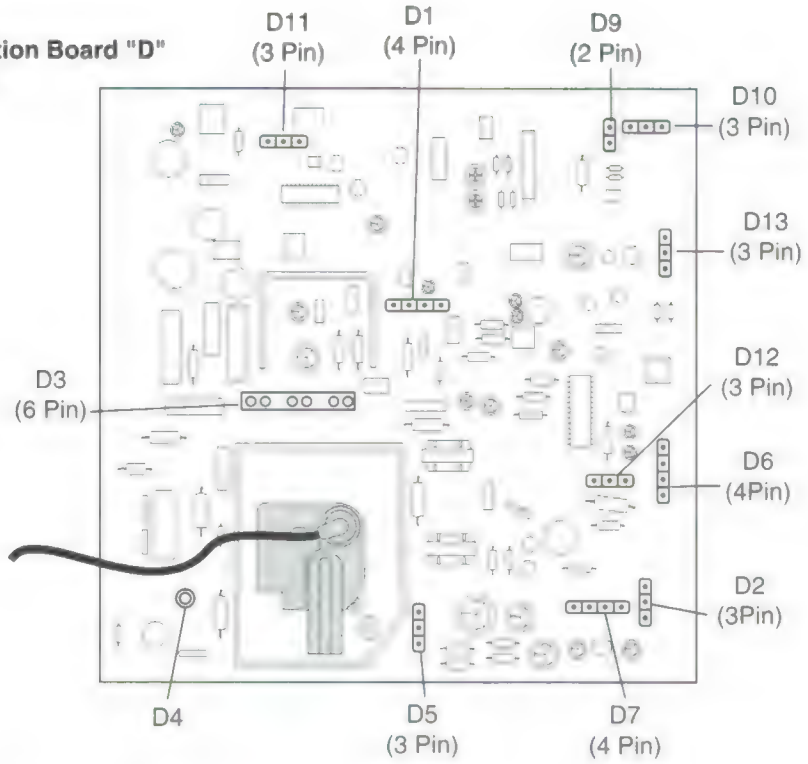
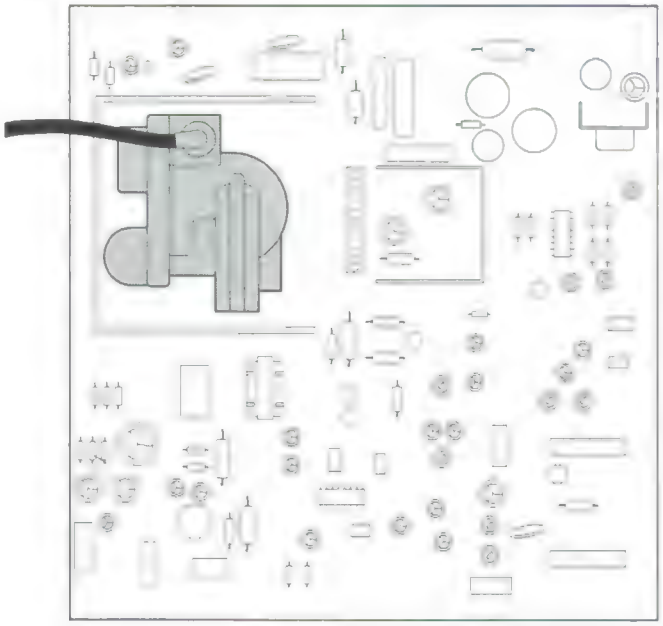


Figure 44. AppleColor Hi-Res RGB Exploded View

Deflection Board "D"
Rev. A



Deflection Board "D"
Rev. B



Note:
You can distinguish Rev. B from Rev. A by the high-voltage capacitor on the Rev. A board.

Refer to the *Service Source CD*, Take Apart chapter, Deflection Board D, Rev. A, step 5, for further information.

Figure 45. AppleColor Hi-Res RGB Main Deflection Boards

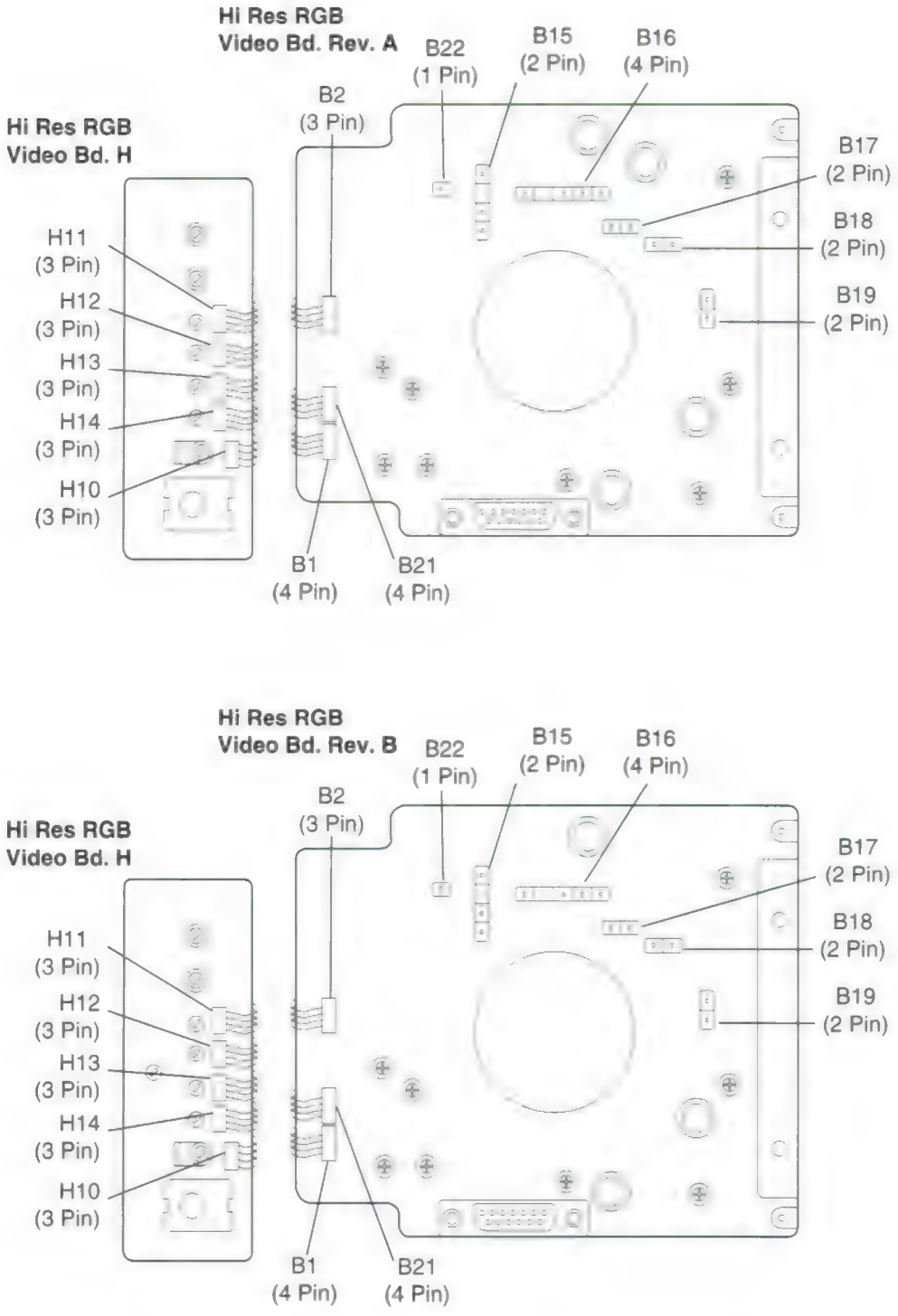


Figure 46. AppleColor Hi-Res RGB Video Boards

Parts List

Adjustment Panel Cover	949-0127
AppleColor High-Res RGB Adjustment: Sub-Brightness	011-7088
Bezel, Plastic Case (w/o product ID label)	949-0113
C522, 0.022µF, 50 V, Mylar	121-0117
C525, 0.047µF, 50 V, Mylar	121-0118
Cable Assembly, LED	590-0439
Cable, CPU to Monitor, 1.75 Meter	590-4161
Cable, External Power, Domestic (120 V)	590-0372
Cable, External Power, European (220 V)	590-0422
Contrast Control Board (J), Rev. A	905-0003
Contrast Control Board (J), Rev. B	905-0012
CRT Assembly, Rev. A	076-0245
CRT Assembly, Rev. B	076-0393
CRT Board (C), Rev. A	981-0006
CRT Board (C), Rev. B	982-0077
Deflection Board, Rev. A	661-0399
Deflection Board, Rev. B	661-0654
Degaussing Switch	937-0026
Facilitation Warranty Reimbursement, Per Repair	011-0083
Fuse, 250 V, 3.15 Amp	740-0108
Fuse, 250 V, 6.3 Amp (F101)	740-0109
Height Adjustment Bar	815-1182
High-Voltage Capacitor (Rev. A Only)	910-0058
Label, Rear Cover, Product ID	825-1726
Power Supply, Rev. A	661-0397
Power Supply, Rev. B	661-0705
Rear Cover, Plastic	949-0114
Screw/Knob Set	956-0007
Shimmer Correction Adjustment	011-7095
Stand Attachment, Plastic Bottom	949-0115
Video Color Board, Rev. A	661-0398
Video Color Board, Rev. B	661-0653

Symptom/Cure Chart

Use the following symptom cure chart as a troubleshooting guide. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see Chapter 1, "General Monitor Information."

For additional assistance, contact Apple Technical Support.

No Video	Solutions
No video, LED off (condition may occur after monitor has been on for a few minutes)	1. Ensure that monitor's video cable is connected to the computer or to the video card in the computer. 2. Check that the power cord is properly connected. 3. Check internal power connectors. 4. Replace blown fuse. 5. If the deflection board is a rev. A board, replace the high-voltage capacitor. 6. Replace deflection board "D." 7. Replace power supply.
No video, LED on	1. Ensure that monitor's video cable is connected to the computer or to the video card in the computer. 2. Adjust the contrast and brightness controls. 3. Verify that all connectors on the power supply and deflection board "D" are secure. 4. Verify that the video card (in the CPU) is working properly. 5. Replace video board "C." 6. Replace video color board assembly "B." 7. Replace CRT.

Geometry	Solutions
Video image size small/large, short/tall, narrow/wide	1. Adjust the horizontal[1] or vertical size controls. 2. Replace deflection board "D." 3. Replace CRT.

1. When using the Rev. A version of the High-Resolution RGB Monitor with a Macintosh LC, the width of the raster/image area is reduced 3/16 inch from both sides of the screen. Adjust the horizontal size.

Video image not centered	1. Verify that distortion is not caused by environmental conditions. Move monitor to a different location. 2. Adjust the horizontal shift or vertical shift control (as appropriate) on video board "H." 3. Replace the deflection board "D."
Vertical linearity bad (screen top and bottom differ)	1. Adjust V.LIN control. 2. Replace the deflection board "D."
Video image fades in and out	Replace video board "C."
Abnormal/distorted raster (other than above)	1. Verify that distortion is not caused by environmental conditions. Move monitor to a different location. 2. Verify that all connectors are correctly placed and secure. 3. Perform appropriate geometric adjustments. 4. Replace deflection board "D."

Synchronization	**Solutions**
Picture breaks into diagonal lines	1. Connect another monitor to the computer and verify video signal. 2. Replace deflection board "D."
Picture rolls vertically	1. Connect another monitor to the computer and verify video signal. 2. Verify that the video card is working properly. 3. Replace deflection board "D."
Single vertical line on screen	1. Check yoke connectors. 2. Replace deflection board "D." 3. Replace CRT.
Single horizontal line appears[2]	1. Verify that the yoke connectors are tight. 2. Replace deflection board "D." 3. Replace CRT.

2. A thin, gray, horizontal line may be visible across the bottom third of a lit screen. This line is inherent in the design of Trinitron monitors. Do not replace modules.

Video/Color	Solutions
Predominant red, blue or green color tint	1. Verify that the video card (in CPU) is working properly. 2. Check monitor-to-computer connections. 3. Perform White Balance adjustment procedure. 4. Replace video color board assembly. 5. Replace CRT.
Picture too dark or too bright	1. Adjust brightness and contrast controls. 2. Verify that the video card (in CPU) is working properly. 3. Set cutoff control on video board "H". 4. Adjust White Balance. 5. Replace video color board assembly. 6. Replace deflection board "D."
Brightness or contrast cannot be adjusted	1. Replace video color board assembly. 2. Replace contrast control board "J."
Picture out of focus	1. Adjust the focus control on video board "H.". 2. Replace deflection board "D." 3. Replace video board "C." 4. Replace video color board assembly. 5. Replace CRT.
Picture out of focus, with color-shadowed characters[3]	1. Perform the convergence adjustment procedure. Then adjust focus control, on video board "H," if necessary. 2. Replace deflection board "D." 3. Replace CRT.
Focus cannot be adjusted	1. Replace deflection board "D." 2. Replace video board "C." 3. Replace video color board assembly "B." 4. Replace CRT.

3. Colors in the Crosshatch pattern indicate a convergence problem. (If you cannot see any colors and the display is fuzzy or the characters on the focus pattern are unclear, the problem is focus rather than convergence.)

Miscellaneous	Solutions
Intermittently shuts down (LED does not light)	1. Ensure that monitor's video cable is connected to the computer or to the video card in the computer. 2. Perform cutoff adjustment. 3. Replace high-voltage capacitor. 4. Replace deflection board "D."
Picture jitters or flashes	1. Check that all ground cables are secure. 2. Verify that adjacent computer equipment is properly grounded. Move electrical devices away from the monitor. Temporarily shut off all fluorescent lights in the area. 3. Replace deflection board "D."
Black screen spots (burnt phosphors)	Replace CRT.
Monitor emits high-pitched noise	Replace deflection board "D."
Degauss button does not correct uneven patches of color	Replace power supply.

Jitter Correction

Monitors may exhibit a jitter problem in which the raster moves vertically, alternately stretching and shrinking. The problem may occur immediately after you switch on the monitor, or after the monitor is warm. The problem is often intermittent. This topic tells you how to correct the jitter by adding a capacitor to the Rev. A deflection board "D" and by adjusting the vertical hold.

Capacitor Installation

▲ Warning **Avoid high-voltage areas on the solder side of deflection board D.**

1. Use Display Service Utility to display the Crosshatch I or II test pattern.
2. Switch off monitor power and remove the monitor cover and EMI shield.
3. Check deflection board "D" (see Figure 47A) for capacitors C522 and C525.
4. If both capacitors are installed, perform the Geometry adjustments in this chapter.
5. If capacitor C522 is missing, install a new capacitor (see Figure 47B).
6. Using a low-wattage soldering iron and needlenose pliers, solder capacitor C522 (0.022 µF) to the two holes marked C522.
7. Perform the Geometry adjustments.
8. If capacitor C525 is missing, install a new capacitor.

▲ Caution **When installing capacitor C525, be careful not to damage the board. Do not overheat the board. Scrape away only the top layer of insulating material from the surface of the board and leave the copper layer intact**.

9. Using a small knife, scrape away a small section of insulating material at point X (see Figure 47C).
10. Using a low-wattage soldering iron, place a small bead of solder at point X (see Figure 47C).

▲ Caution **Be careful not to short the capacitor leads to any other solder connections.**

11. Lay capacitor C525 (0.047 µF) on its side, and solder it between IC501 pin 22 and point X (see Figure 47D).

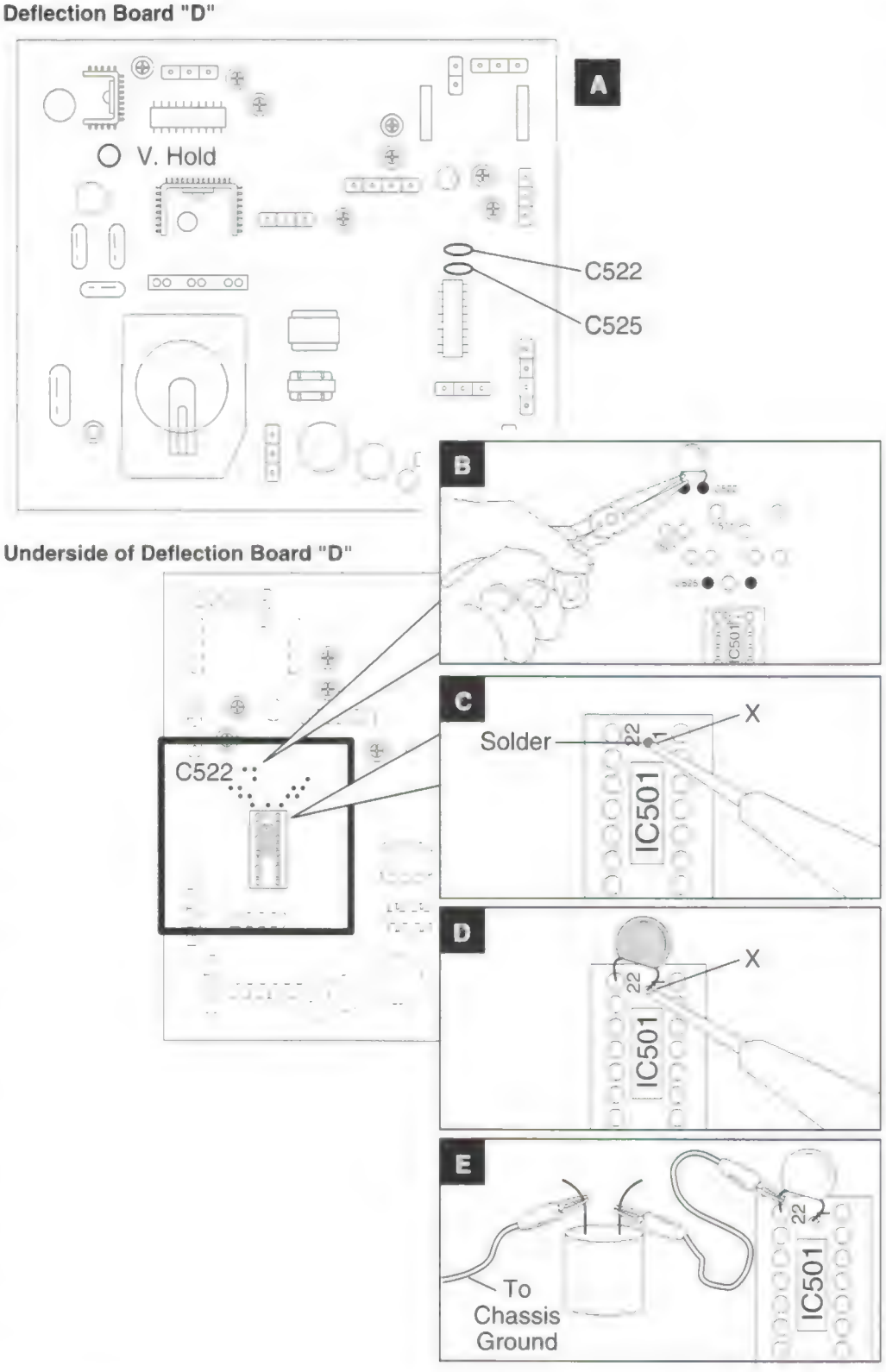


Figure 47. AppleColor Hi-Res RGB Capacitor Installation

Vertical Alignment

1. Connect an alligator lead between the negative end of a 330 µF capacitor and the monitor chassis ground (see Figure 47E).

▲ Caution **Be sure the alligator clip does not slip off pin 22 and touch the surface of the board. Contact with the board can prevent you from properly adjusting the vertical alignment.**

2. Connect a second alligator lead between the positive (unmarked) end of the 330 µF capacitor and pin 22 on IC501.
3. Switch on monitor power.

▲ Warning **The entire yoke assembly has very high voltage. To prevent electrical shock, do not touch the yoke assembly, the anode wire, or the yoke wires.**

4. Use the adjustment tool (part number 949-0386) to carefully adjust the V-HOLD control until four or five horizontal gray bars appear on the monitor screen.
5. Remove the 330 µF capacitor.

Geometry

▲ Warning **This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review the CRT safety rules in Chapter 1, "General Monitor Information."**

Note Reference the "Video Adjustments Foldout," Figure 48, when performing all Geometry and Video adjustments. Unfold Figure 48 so the graphic is visible while making adjustments.

Perform the geometry adjustments in order. Although the geometry controls are shown in the Figure 48 with the rear cover removed, you can access them from the service access panel at the rear of the monitor.

▲ Caution **Do not attempt yoke adjustments on this monitor. All such adjustments have been set by the manufacturer.**

Horizontal Size

Note Because of video features and timing differences across the Apple line of Macintosh computers, the width of the image area on the Hi-Res RGB monitor may vary up to 3/16 inch at each side of the display. Perform the horizontal size adjustment to set the display to its proper width.

1. Use Display Service Utility to display the All-White Screen test pattern.
2. Using a plastic screwdriver, adjust the H-SIZE control (see Figure 48A) until the raster width is 9 1/4 in. (± 1/8 in.) or 235 mm (± 2 mm).

Vertical Size

1. Use Display Service Utility to display the Crosshatch II (white background) test pattern.
2. Using a plastic screwdriver, adjust the V-SIZE control (see Figure 48A) until the raster height is 7 in. (± 1/8 in.) or 176 mm (± 2 mm).

Focus

1. Use Display Service Utility to display the Focus test pattern.
2. Using a plastic screwdriver, adjust the focus control (see Figure 48A) for the best clarity at points halfway between the center and the left and right edges of the screen.

Video

▲ Warning **This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review the CRT safety rules in Chapter 1, "General Monitor Information."**

Cutoff

Always perform the cutoff adjustment whenever you replace the CRT assembly, deflection board D, or the video color board.

1. Remove the monitor's rear cover, EMI shield, and video cable from the back of the monitor. Switch on the monitor.

Note Perform the cutoff and White Balance adjustments in a dimly lit room after the monitor has been on for at least 10 minutes.

2. Set the external (user) contrast knob to maximum and the external brightness knob to the center (detent) position (see Figure 48A).
3. Using the plastic screwdriver, adjust the following controls (see Figure 48A) on the video color board (B board) to midrange:

- B.BKG (R.BKG on Rev. B version)
- G.BKG
- R.BKG (B.BKG on Rev. B version)
- R.DRIVE
- G.DRIVE
- B.DRIVE
- SUB CONT
- SUB BRT

4. Set the voltmeter to measure 140 V DC.
5. Attach the voltmeter ground lead (black lead) to the monitor chassis.
6. Connect the voltmeter red lead to the cathode marked KR (see Figure 48A) on the CRT board ("C" board). Gradually adjust the R.BKG control until the voltage measures 140 V (± 2 V).
7. Connect the voltmeter red lead to the pin marked KG (see Figure 48A) on the CRT board ("C" board). Gradually adjust the G.BKG control until the voltage measures 140 V (± 2 V).
8. Connect the voltmeter red lead to the pin marked KB (see Figure 48A) on the CRT board ("C" board). Gradually adjust the B.BKG control until the voltage measures 140 V (± 2 V).

Note If you increase the cutoff control (clockwise) too far, the monitor might shut down. If this happens, switch off the monitor and turn the cutoff control all the way down (counterclockwise). Wait 30 seconds, switch on the monitor, and resume the adjustment. Using a plastic screwdriver, adjust the cutoff control until the raster is just visible.

9. Turn the cutoff control counterclockwise until the raster just disappears. Once the cutoff control on the video color board (H board) is correct, do not move it again unless you repeat the cutoff adjustment. The life of the picture tube decreases severely if the cutoff adjustment is incorrect.

White Balance

Verify that the cutoff is correct before you proceed. The life of the picture tube decreases severely if the cutoff adjustment is incorrect.

1. Switch off the monitor, connect the video cable, and switch the monitor back on.
   - Use Display Service Utility to display the Gray Bars test pattern. Using the plastic screwdriver, alternately adjust the B.BKG, G.BKG, and R.BKG controls (see Figure 48A) until

- The left (dark) three bars have no colored tint.
- The leftmost bar is as black as the screen border.
- You can barely distinguish the second bar from the black bar.
- The third bar is a dark gray.

Note To achieve good color balance, try reducing the background of the predominant color. If necessary, increase the other background controls until you see no color tint.

Important Readings differ from light meter Model L-248 and Model 246. Note which meter you are using before making adjustments. (See the section, "Light Meters" in Chapter 1, "General Monitor Information.")

2. Using the light meter and a two-inch plastic screwdriver, adjust the G.DRIVE control (see Figure 48A) until the luminance of the rightmost (brightest) bar measures 24 foot lamberts (± 3 foot lamberts), which on the light meter is
   - Model L-248: 9 to 10 on the 2-10 scale
   - Model 246: 19 on the red scale
3. Adjust the R.DRIVE and B.DRIVE controls (see Figure 48A) until you see no predominant color in the three right (brightest) bars.
4. As necessary, repeat the G.DRIVE, R.DRIVE, and B.DRIVE adjustments.
5. If the left (darkest) bars now show a predominant color, readjust the background controls (B.BKG, G.BKG, and R.BKG) of the two nonpredominant colors until you see only shades of black and gray.

Note The White Balance is correct if
- You see no predominant color.
- The brightest bar measures 24 foot lamberts (± 3 foot lamberts) or 9 to 10 on light meter Model L-248 or 19 on light meter Model 246.
- The left (darkest) bars are black, barely distinguishable, and dark gray.

If additional fine tuning is necessary, adjust the sub-contrast and sub-brightness controls in the next steps.

Sub-Contrast

Adjust the SUB CONT control (see Figure 48A) so that the luminance in the middle of the rightmost (brightest) bar measures 24 foot lamberts (± 3 foot lamberts), which is

- Model L-248: middle of the 9 scale
- Model 246: 19 on the red scale

Sub-Brightness

Adjust the SUB BRT (see Figure 48) control so that the leftmost bar is completely black and the next bar is barely distinguishable from the black bar.

Convergence

▲ Caution **This adjustment differs from geometric convergence, which is a factory adjustment of the magnets on the yoke of the CRT. Do not attempt to set convergence by tampering with the yoke magnets.**

1. Use Display Service Utility to display the Crosshatch I test pattern.
2. Allow the monitor to warm up for 15 to 20 minutes.
3. Check the crosshatch lines on the test pattern for the following conditions:
   - If the lines are pure white, the monitor color convergence does not need adjusting.
   - If the lines show colored shadows at the edges, go to Step 4.
4. Use the following adjustment if the monitor's red, blue, and green color beams do not align properly and the images on the screen are shadowed or out of focus. The convergence adjustment controls are on the H Board and the C Board (see Figure 48A).
5. Press the degauss switch and remove the service panel cover.
6. Turn the V-STAT control (see Figure 48A) until the color-shadowed horizontal lines blend to solid white lines.
7. Turn the H-STAT control (see Figure 48A) until the color-shadowed vertical lines blend to solid white lines.

Note Perform the next step only if you cannot adjust the horizontal convergence using the H-STAT control.

8. Switch off monitor power and remove the monitor cover, the EMI shield, and the metal video board shield the covers the C Board..
9. Adjust the H-STAT control on the C Board (see Figure 48A) until the color-shadowed vertical lines blend to solid white lines.
10. If the lines still show color, go to the next step.

Note Perform the following steps only if you could not adjust the monitor's color convergence with the previous steps. Be sure the monitor has been on for at least 15 to 20 minutes.

11. Use Display Service Utility to display the Crosshatch I or II pattern.

12. If the horizontal lines at the top of the monitor are out of adjustment, use the adjustment tool (part number 949-0386) to adjust the V-TOP (RV518) control (see Figure 48B) until the color-shadowed lines blend to solid white lines.

13. If the horizontal lines at the bottom of the monitor are out of adjustment, use the adjustment tool (part number 949-0386) to adjust the V-BOTTOM (RV517) control (see Figure 48B) until the color-shadowed lines blend to solid white lines.

Geometric Distortion

Note Perform the following adjustments only if your attempts to adjust raster distortions with the external controls did not produce the results you wanted.

1. Use Display Service Utility to display the Crosshatch I or II test pattern.

2. Verify that the boxes on the top row are the same size as the boxes on the bottom row, and the boxes on the left side are the same as the boxes on the right side.

▲ Warning **The entire yoke assembly has very high voltage. To prevent electrical shock, do not touch the yoke assembly, the anode wire, or the yoke wires.**

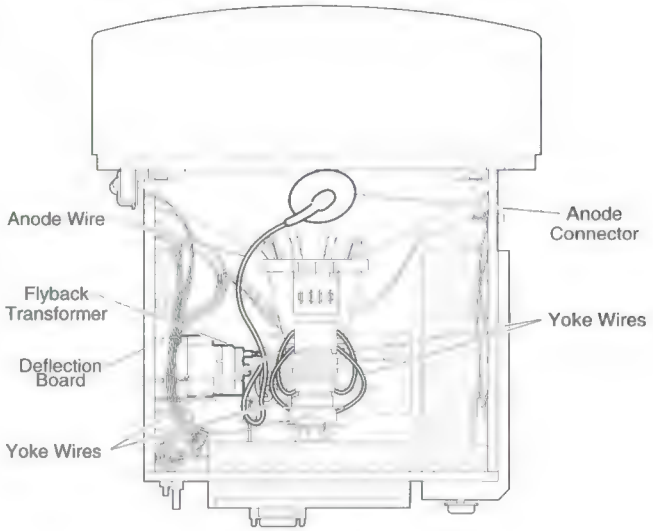
3. To determine which potentiometer (pot) to adjust, compare the display with the distortions shown in Figure 48C. Using the adjustment tool (Apple part number 949-0386), adjust the correct pot.

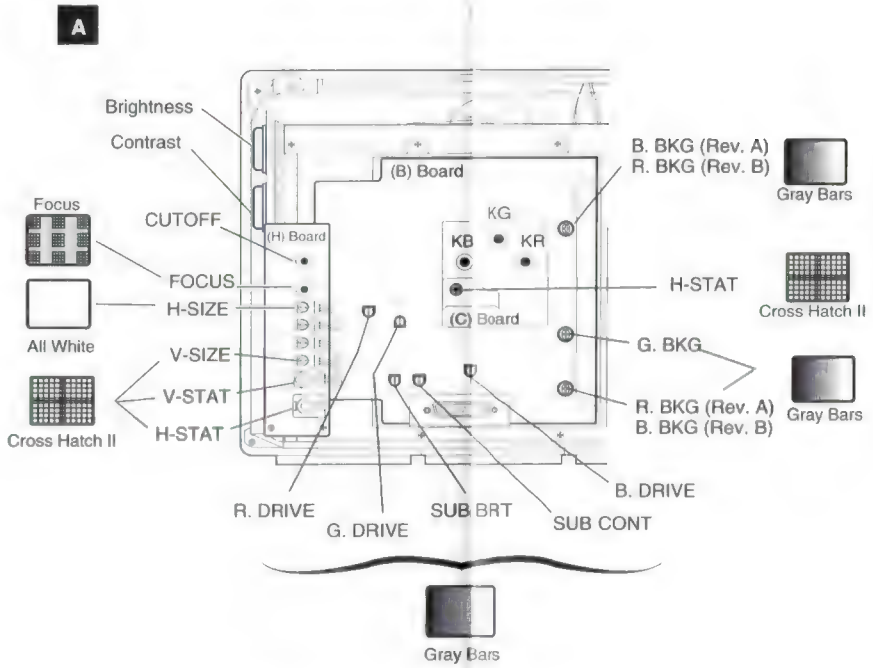
4. If the display is so distorted that you can't tell which adjustments to make, using the adjustment tool, perform the adjustments (see Figure 48C for adjustment locations) in the following sequence:
   - PIN AMP
   - PIN PHASE
   - V. ANGLE
   - V. BOW
   - Repeat V. ANGLE
   - Repeat PIN PHASE

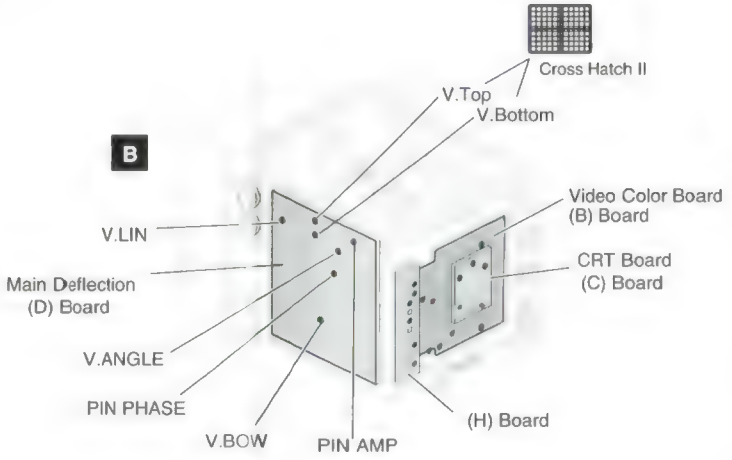
5. If you can't correct the distortion, replace deflection board "D." See Figure 48B for board location.

Safety • WARNING •

Serious Injury could result if, with the power on, you touch any of the high-voltage area shown below. Review the CRT safety rules before preforming adjustments.







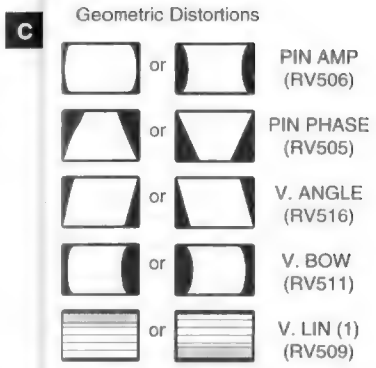


Figure 48. Apple Color High-Resolution RGB Video Adjustments

Apple Basic Color Monitor
(Whole Unit Exchange)

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Parts List

Note There are multiple versions of the Apple Basic Color Monitor, which is whole unit exchange. Locate the manufacturing part number (645-xxxx) on the product label on the back of the monitor. Use this number to aid you in ordering the correct "661" part number.

Apple Basic Color Monitor (whole unit), Australia, (645-0031) X661-0008
Apple Basic Color Monitor (whole unit), Australia, (645-0032) X661-0009
Apple Basic Color Monitor (whole unit), US/Pacific, (645-0031) 661-0008
Apple Basic Color Monitor (whole unit), US/Pacific, (645-0032) 661-0009
Apple Basic Color Monitor (whole unit), Europe, (645-0034) Z661-0010
Apple Basic Color Monitor (whole unit), Rev B[1], US, (645-0029) 661-1670
Cable, Adapter (15-pin 3 row to DB-15) 922-1104
Display, (whole unit), Apple Basic Color 661-1040
Display, (whole unit), Apple Basic Color, Non-VGA[2] 661-1670

1. These units can be further distinguished from the original Apple Basic Color Monitor by its platinum color.
2. Compatible with Macintosh only. Customers needing a VGA monitor should order 661-1040, which supports both Macintosh and VGA.

Symptom/Cure Chart

Use the following symptom/cure chart as a troubleshooting guide. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see Chapter 1, "General Monitor Information."

For additional assistance, contact Apple Technical Support.

No Video	Solutions
No video, LED off	1. Ensure that monitor's video cable is connected to the computer or to the video card in the computer. 2. Replace monitor.
No video, LED on	1. Ensure that monitor's video cable is connected to the computer or to the video card in the computer. 2. Replace monitor.

Geometry	Solutions
Video image too short, tall, narrow, or wide	Replace monitor.
Video image not centered	1. Verify that distortion is not caused by environmental conditions. Move monitor away from fluorescent lights or other electrical equipment. 2. Adjust geometry controls. 3. Replace monitor.
Abnormal or distorted video image	1. Verify that distortion is not caused by environmental conditions. Move monitor away from fluorescent lights or other electrical equipment. 2. Adjust brightness and contrast. 3. Replace monitor.

Synchronization	Solutions
Picture breaks into diagonal lines	Replace monitor.
Picture rolls horizontally or vertically	Replace monitor.
Single vertical or horizontal line appears on screen	Replace monitor.

Video	Solutions
Predominant color tint	Replace monitor.
Picture too dark or too bright	1. Adjust brightness and contrast controls. 2. Replace monitor.
Cannot adjust brightness or contrast	Replace monitor.
Out of focus	Replace monitor.

Miscellaneous	Solutions
Out of convergence	Replace monitor.
Picture jitters or flashes	1. Verify that distortion is not caused by environmental conditions. Move monitor away from fluorescent lights or other electrical equipment. 2. Check all ground cable connections. 3. Replace monitor.
Black spots appear on screen (burnt phosphor)	Replace monitor.

Apple AudioVision 14 Display

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Exploded View

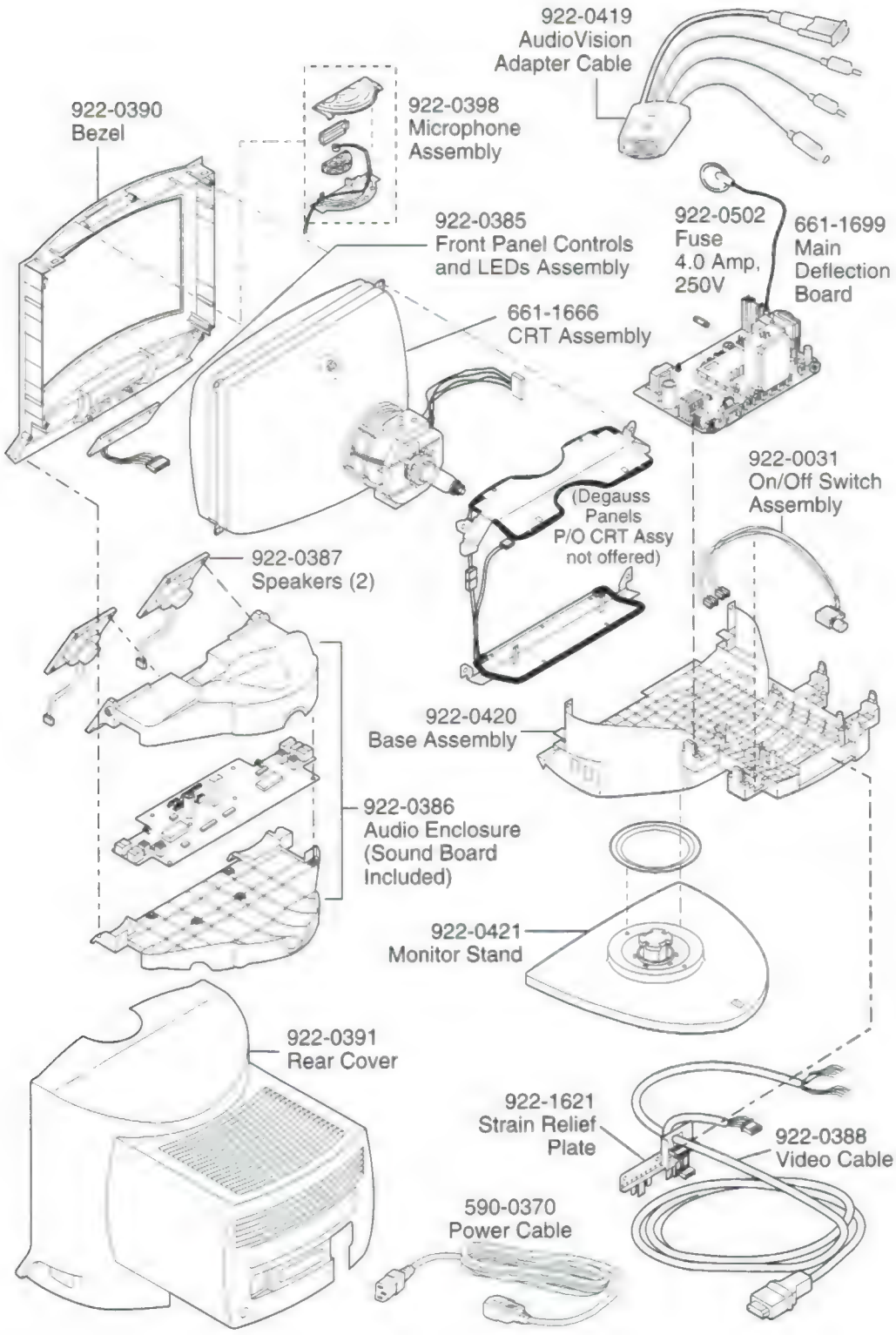


Figure 49. AudioVision 14 Display Exploded View

Main Circuit Board

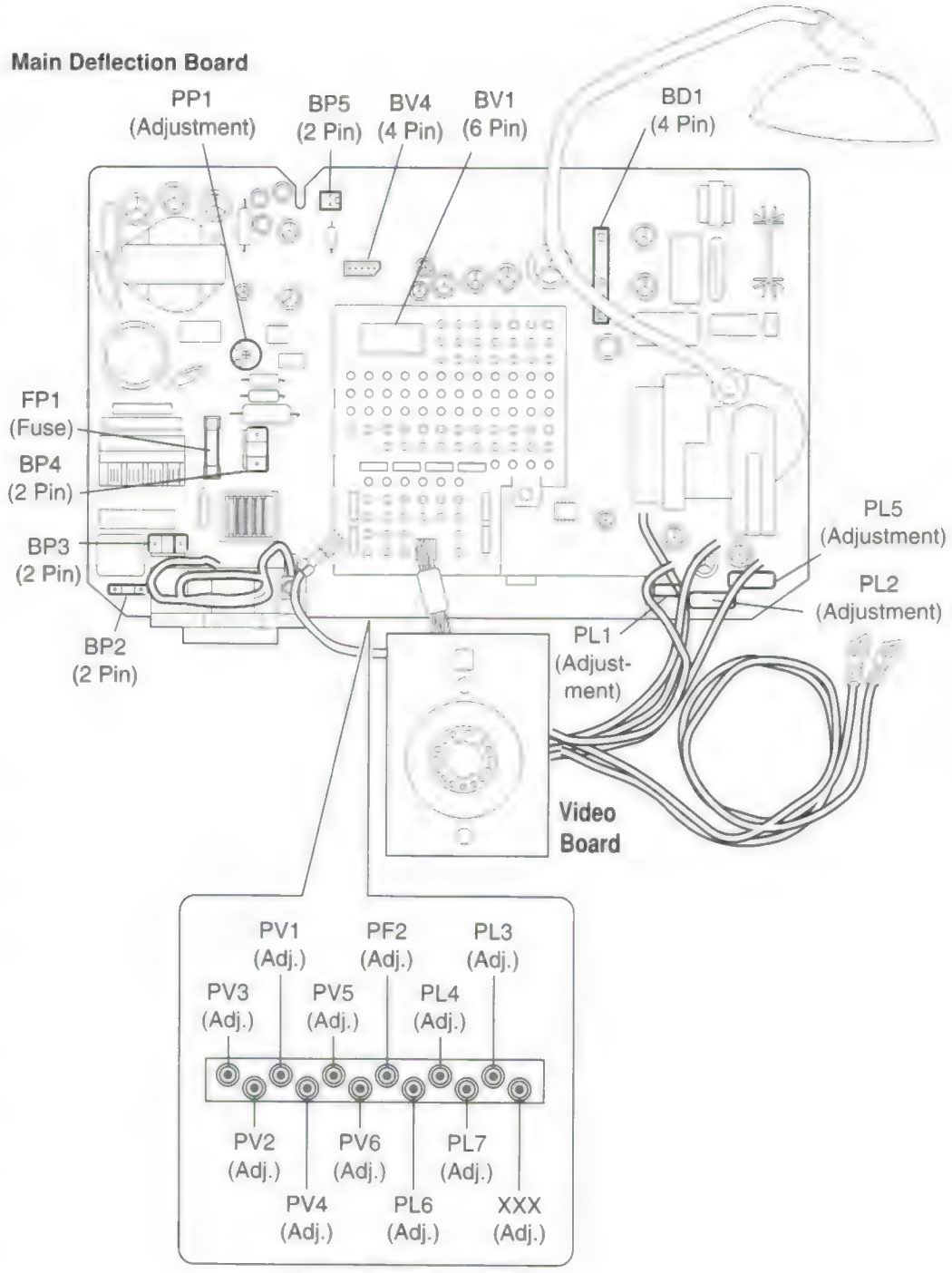


Figure 50. AudioVision 14 Display Main Deflection Board

Parts List

Adapter Cable, 45 Pin	922-0419
Apple AudioVision 14 Display Warranty Reimbursement	011-0097
Audio Enclosure	922-0386
Base Assembly	922-0420
Bezel, Apple AudioVision Display	922-0390
Board, Main Deflection[1]	661-1699
Board, Main Deflection, Rev. B, with E. Star Compliance[2]	661-0169
CRT Assembly, Australian	661-1667
CRT Assembly, Domestic	661-1666
CRT Assembly, European	661-1668
Front Panel Controls and LEDs Assembly	922-0385
Fuse, 4.0 Amp, 250V (Pkg. of 5)	922-0502
Kit, Cable Assembly	076-0594
Kit, Screw/Knob	076-0195
Label, Rear Cover, Product I.D.	825-0493
Microphone Assembly	922-0389
Monitor Stand	922-0421
On/Off Switch Assembly	922-0031
Power Cable, AC 110 V, Smoke (1M)	590-0370
Power Cable, AC 220 V, Smoke (1M)	590-0420
Rear Cover	922-0391
Speakers (2)	922-0387
Strain Relief Plate	922-1621
Video Cable	922-0388

1. When replacing the 661-1699 main deflection board, replace with either 661-1699 or 661-0169.
2. Order like-for-like when replacing 661-0169.

Troubleshooting

Symptom/Cure Chart

Use the following symptom/cure chart as a troubleshooting guide. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see Chapter 1, "General Monitor Information."

For additional assistance, contact Apple Technical Support.

No Video	Solutions
No video, LED off	1. Ensure that monitor's video cable is connected to the computer or to the video card in the computer. 2. Check power cable connections and power switch. 3. Check all connections on main board. 4. Replace blown fuse. 5. Replace main board.
No video, LED on, CRT filament on	1. Ensure that monitor's video cable is connected to the computer or to the video card in the computer. 2. Adjust contrast and brightness knobs. 3. Connect known-good monitor and verify that built-in video signal or video card is working properly. 4. Check all connections on main board. Verify that video connector is secure and wires are inside plastic connector. 5. Perform video adjustments. Refer to "Video" in "Adjustments" section. 6. Replace main board. 7. Replace CRT.
No video, or dim video image	1. Shut down the Macintosh. 2. Turn power off on monitor and CPU. 3. Disconnect AudioVision 14 Monitor power cable for 30 seconds. 4. Reconnect AudioVision 14 Monitor power cable. 5. Switch monitor back on while depressing the Brightness Up and Microphone buttons[3]. (These are the second and fifth buttons from the left.)

3. This two-button reset procedure resets the CPU inside the Sound Module. Resetting the monitor should always be tried prior to replacing the sound module.

Geometry	Solutions
Video image too short, tall, narrow, or wide	1. Adjust vertical or horizontal size controls. Refer to "Geometry" in "Adjustments" section. 2. Replace main board.
Video image not centered	1. Move unit away from monitors, fluorescent lights, or other electrical equipment. 2. Adjust vertical or horizontal center controls. Refer to "Geometry" in "Adjustments" section. 3. Replace main board.
Horizontal linearity bad (size of text differs at sides of screen)	Replace main board.
Vertical linearity bad (size of text differs at top versus bottom of screen)	Replace main board.
Abnormal or distorted video image	1. Move unit away from monitors, fluorescent lights, or other electrical equipment. 2. Perform geometry adjustments. Refer to "Geometry" in "Adjustments" section. 3. Replace main board. 4. Replace CRT (rarely required).
Entire video image is tilted.	1. Move unit away from monitors, fluorescent lights, or other electrical equipment. 2. Perform geometry adjustments. Refer to "Geometry" in "Adjustments" section. 3. Perform geometric distortion adjustments. Refer to "Geometric Distortion" in "Adjustments" section. 4. Replace main board.

Synchronization	Solutions
Picture breaks into diagonal lines	1. Connect known-good monitor and verify that built-in video signal or video card is working properly. 2. Replace main board.
Picture rolls vertically	1. Connect known-good monitor and verify that built-in video signal or video card is working properly. 2. Replace main board.

Picture breaks and rolls horizontally	1. Connect known-good monitor and verify that built-in video signal or video card is working properly. 2. Replace main board.
Black screen with single vertical or horizontal line	1. Replace main board. 2. Replace CRT.

Video	**Solutions**
Image too dark, too bright, or washed out	1. Adjust external contrast and brightness controls. 2. Connect known-good monitor and verify that built-in video signal or video card is working properly. 3. Perform video adjustments. Refer to "Video" in "Adjustments" section. 4. Replace main board. 5. Replace CRT (rarely required).
Out of focus	1. Perform focus adjustment. Refer to "Video" in "Adjustments" section. 2. Replace main board. 3. Adjust focus controls to their limits. If bad focus remains on one part of display, replace CRT.
Predominant color tint	1. Check video card in computer. 2. Perform video adjustments. Refer to "Video" in "Adjustments" section. 3. Replace main board. 4. Replace CRT (if you cannot eliminate red, green, or blue tint).
Out of convergence (color bleeding out from text or lines)	1. Connect known-good monitor and verify that built-in video signal or video card is working properly. 2. Perform convergence adjustments. Refer to "Video" in "Adjustments" section. 3. Replace main board. 4. Replace CRT.

Audio	**Solutions**
Sound comes out of only one speaker	One of sound output options may be set to Stereo when computer is only capable of mono sound output.

Internal microphone doesn't record	1. To turn on microphone, press microphone button on keypad. "Microphone-on" LED illuminates when microphone is on. 2. Verify that monitor is selected as sound input and playback source.
No sound or volume is too low	1. Verify that external sound sources are securely connected to monitor's sound-out port. 2. Press volume key on keypad. 3. Press mute button to turn off mute. 4. Press microphone button to turn off microphone.

Miscellaneous	**Solutions**
Picture jitters or flashes	1. Move unit away from monitors, fluorescent lights, or other electrical equipment. 2. Check that all ground cables are secure. 3. Replace main board.
Intermittently shuts down	Replace main board.
Flashing or wavy screen	Replace main board.
Black screen spots (burnt phosphor)	Replace CRT.
Monitor emits high-pitched noise	Replace main board.
Does not degauss	Replace main board.
Erratic or no communication with ADB device	Replace keyboard cable, keyboard, mouse, or other ADB device.
"AudioVision" extension boots with an "X" through it.	1. Shut down the Macintosh. 2. Turn power off on monitor and CPU. 3. Disconnect AudioVision 14 Monitor power cable for 30 seconds. 4. Reconnect AudioVision 14 Monitor power cable. 5. Switch monitor back on while depressing the Brightness Up and Microphone buttons[4]. (These are the second and fifth buttons from the left.)

4. This 2-button reset procedure resets the CPU inside the Sound Module. Resetting the monitor should always be tried prior to replacing the sound module.

Control Panel	Solutions
Sound control panel doesn't display "AudioVision" option in the pull-down menu.	1. Shut down the Macintosh. 2. Turn off power on monitor and CPU. 3. Disconnect AudioVision 14 Monitor power cable for 30 seconds. 4. Reconnect AudioVision 14 Monitor power cable. 5. Switch monitor back on while depressing the Brightness Up and Microphone buttons[5]. (These are the second and fifth buttons from the left.)
Unable to launch the Video control panel. Instead the message "The Video control panel can't be opened because no video panels are installed."	1. Shut down the Macintosh. 2. Turn off power on monitor and CPU. 3. Disconnect AudioVision 14 Monitor power cable for 30 seconds. 4. Reconnect AudioVision 14 Monitor power cable. 5. Switch monitor back on while depressing the Brightness Up and Microphone buttons. (These are the second and fifth buttons from the left.)
The Monitors control panel doesn't display bit depth selections.	1. Shut down the Macintosh. 2. Turn off power on monitor and CPU. 3. Disconnect AudioVision 14 Monitor power cable for 30 seconds. 4. Reconnect AudioVision 14 Monitor power cable. 5. Switch monitor back on while depressing the Brightness Up and Microphone buttons. (These are the second and fifth buttons from the left.)

5. This two-button reset procedure resets the CPU inside the Sound Module. Resetting the monitor should always be tried prior to replacing the sound module.

Adjustments

▲ Warning **This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review the CRT safety rules in Chapter 1, "General Monitor Information."**

Geometry

The controls on this monitor require a small hex-head plastic tool to make adjustments. If the tool is long, it will be too flexible, which will make fine adjustments difficult. Use a short hex-head plastic tool to minimize flexing. Do not use metal alignment tools because they are a shock hazard.

Note Reference the "Video Adjustments Foldout," Figure 51, when performing all Geometry and Video adjustments. Unfold Figure 51 so the graphic is visible while making adjustments.

▲ Caution **Adjustments should be performed only after a 15-minute warm-up period.**

Centering

1. Use Display Service Utility to display the All-White Screen test pattern. Refer to the "Diagnostics" section of Chapter 1 for more information.
2. Using a hex-head plastic adjustment tool, adjust the vertical and horizontal center (see Figure 51B) until the video image is centered on the screen.

Size

Because of video features and timing differences across the Apple line of Macintosh computers, the width of the image area on the AudioVision 14-Inch Display may vary up to 3/16 inch at each side of the display. Perform the horizontal size adjustment to set the display to its proper width.

1. Using a hex-head plastic adjustment tool, adjust the vertical height control (see Figure 51B) until the video image height is 7 in. (± 1/8 in.) or 176 mm (± 2 mm). Verify this height.
2. Using a hex-head plastic adjustment tool, adjust the horizontal width control (see Figure 51B) until the video image is 9 1/4 in. (± 1/8 in.) or 235 mm (± 2 mm).

Focus

1. Display the Focus test pattern.
2. Using a hex-head plastic adjustment tool, adjust the focus control (see Figure 51C) until the Focus test pattern is as clear as possible.

Video

Perform the Cutoff adjustment prior to adjusting the White Balance and whenever you replace the CRT assembly or the main board, after the monitor has been on for at least 10 minutes.

Cutoff

1. Display the Gray Bars test pattern.
2. Set the contrast control to maximum contrast and the brightness control to a medium brightness level (see Figure 51A).
3. Using a hex-head plastic adjustment tool, set the red, green, and blue background controls (see Figure 51D) to full counterclockwise positions.

Note To set the green and blue drive controls to their 3/4 position, turn the controls to their full clockwise position and then turn back 1/4 turn counterclockwise.

4. Set the green and blue drive controls (see Figure 51D) clockwise to their 3/4 position.
5. Set the sub-contrast control (see Figure 51D) to its full clockwise position.
6. Using a hex-head plastic adjustment tool, adjust G2 (see Figure 51C) until the first bar in the test pattern is completely black and the second bar is barely visible.
7. Set the sub-contrast control to the center position.

White Balance

1. Display the Gray Bars test pattern.
2. Set the contrast control to maximum contrast and the brightness control to a medium brightness level (see Figure 51A).
3. Note the predominant color
4. Using a hex-head plastic adjustment tool, alternately adjust the red, green, and blue background controls until no predominant color appears in the four darkest bars.

Note The darkest bar must remain completely black throughout the remainder of the procedure. If you notice a predominant color in the darkest bar, readjust the appropriate background control.

5. If necessary, adjust the blue and green drive controls until no predominant color appears in the four brightest bars.
6. Check the four darkest bars, and if necessary, adjust the red, green, and blue background controls until no predominant color appears.
7. Using Display Service Utility, display the All-White Screen test pattern

Important Readings from light meter Model L-248 and Model 246 differ. Note which meter you are using before making adjustments. Refer to Chapter 1, "General Monitor Information," for light meter setup. Over time, light meter tolerances can vary. If you doubt your meter's accuracy, verify the readings with a known-good light meter or photometer.

8. Using the light meter and a two-inch plastic screwdriver, adjust the sub-contrast control until you get 30 foot lamberts (± 3 foot lamberts), which on the light meter is
   - Model L-248: middle of the 10 scale
   - Model 246: 23 on the red scale

Convergence

1. Display the Crosshatch I test pattern.
2. Using a hex-head plastic adjustment tool, adjust the convergence control (see Figure 51C) on the CRT video board for best overall convergence.
3. Using a hex-head plastic adjustment tool, adjust the N/S amp control for best convergence of horizontal lines at the top and bottom of the screen.
4. Adjust the lower correction control for best convergence of vertical lines at the bottom of the screen.
5. Adjust the upper correction control for best convergence of vertical lines at the top of the screen.

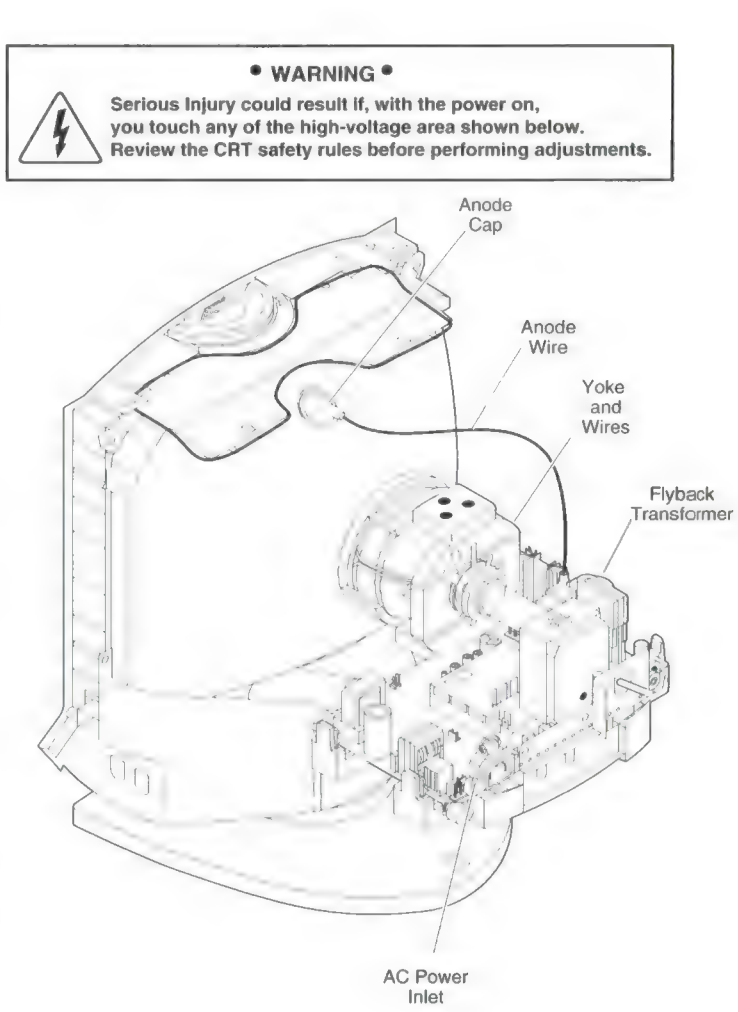
Geometric Distortion

Note Perform the following geometric adjustments only if your attempts to adjust video distortions with the external geometry controls do not produce the results you wanted.

1. Display the Crosshatch I test pattern.
2. Verify that the boxes on the top row are the same size as the boxes on the bottom row, and the boxes on the left side are the same size as the boxes on the right side.

▲ Warning **The entire yoke assembly has very high voltage. To prevent electrical shock, do not touch the yoke assembly, the anode wire, or the yoke wires.**

3. To determine which control to adjust, compare the display with the display distortions (Horizontal Bow, Pin Phase, and Vertical Angle) shown in Figure 51B.
4. Using a hex-head plastic adjustment tool, adjust the control that is appropriate for the distortion.
5. If the display is so distorted that you can't tell which adjustments to make, perform the adjustments in the following sequence:
   - Pin Phase
   - Vertical Angle
   - Horizontal Bow
6. If the display is still distorted, repeat the vertical angle and pin phase adjustments.
7. If you can't correct the distortion, replace the main board.



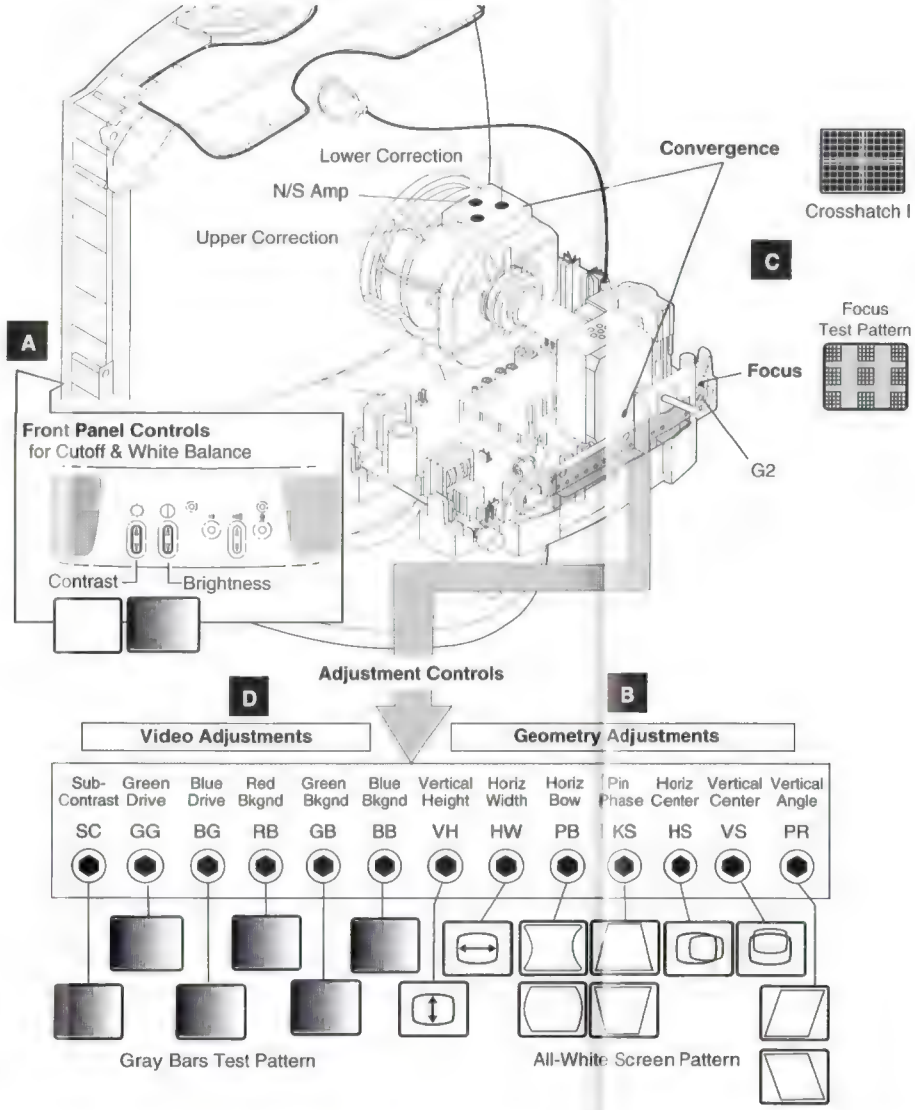


Figure 51. AudioVision 14 Display Adjustments

Apple Color Plus 14" Display
(Whole Unit Exchange)

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Parts List

Note The Apple Color Plus 14" Display monitor is a whole-unit exchange module.

Display, Apple Color Plus 14", Australia X661-0870
Display, Apple Color Plus 14", Japan J661-0870
Display, Apple Color Plus 14", Pacific PA661-0870
Display, Apple Color Plus 14", U.S. 661-0870
Display, AppleColor Plus 14", Europe Z661-0870

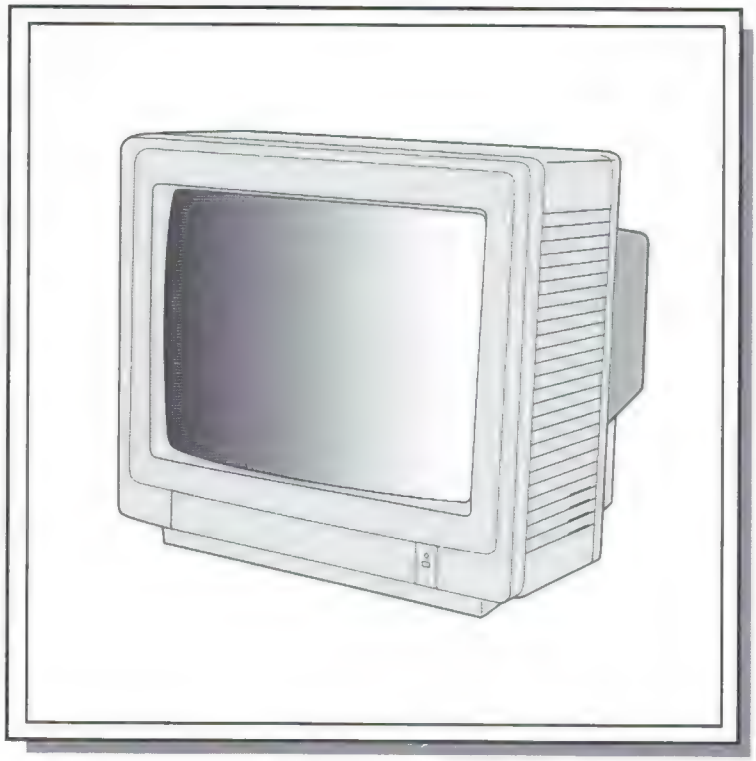
Troubleshooting

The Apple Color Plus 14" Display monitor is a whole-unit exchange module. Removing the case to attempt internal adjustments will void the warranty. Before replacing the unit,

1. Verify the problem with another Apple Color Plus 14" Display. If the condition is not common to Apple Color Plus 14" Displays, go to the next step.
2. Ensure that external interference is not the problem.
3. Verify that distortion is not caused by fluorescent lights or other electrical equipment.
4. Verify that the monitor is at fault by connecting it to a different computer.
5. Check all ground cable connections.

Note This is a low-cost monitor and its performance cannot be compared with higher-end monitors. It is not unusual to have some raster shift and other minor geometry problems.

Apple Performa Display/Plus
(Whole Unit Exchange)



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Parts List

Note The Apple Performa and Performa Plus Displays are whole-unit exchange modules.

Apple Performa Display ,.39 Dot Pitch/Australia X661-0114
Apple Performa Display, .39 Dot Pitch/Europe Z661-0114
Apple Performa Display, .39 Dot Pitch/Pacific PA661-0114
Monitor, Apple Basic Color, Whole Unit, Non-VGA 661-1670
Performa Display, .39 Dot Pitch, US 661-0114
Performa Plus Display, .29 Dot Pitch, US 661-0113
Plus Display, 14" Color Monitor, .29 Dot 661-1669

Locator View

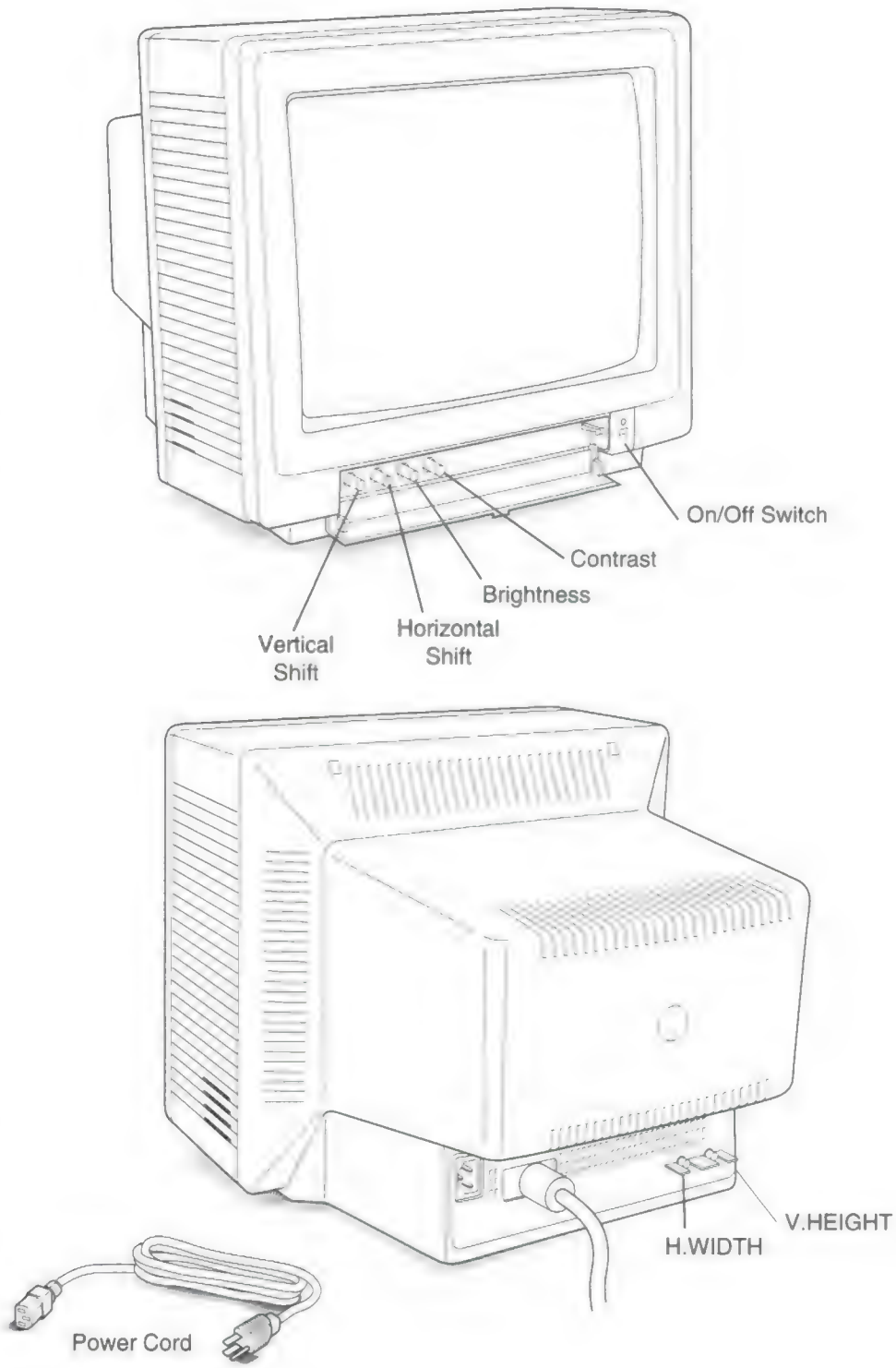

Figure 52. Apple Performa Display/Performa Plus Locator

Symptom/Cure Chart

Use the following symptom/cure chart as a troubleshooting guide. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see Chapter 1, "General Monitor Information."

For additional assistance, contact Apple Technical Support.

Geometry	Solutions
Raster too short, tall, narrow, or wide	Replace monitor.
Raster not centered	Replace monitor.
No raster	Replace monitor.
Abnormal or distorted raster	1. Verify that distortion is not caused by environmental conditions. Move unit away from electrical equipment and shut off fluorescent lights. 2. Adjust brightness and contrast. 3. Replace monitor.

Synchronization	Solutions
Picture breaks into diagonal lines	Replace monitor.
Picture rolls horizontally or vertically	Replace monitor.
Single vertical or horizontal line appears on black raster	Replace monitor.

Video	Solutions
Predominant color tint	Replace monitor.
Picture too dark or too bright	Replace monitor.
Cannot adjust brightness or contrast	Replace monitor.

Miscellaneous	Solutions
Out of focus	Replace monitor.
Out of convergence	Replace monitor.
Picture jitters or flashes	1. Verify that distortion is not caused by environmental conditions. Move unit away from electrical equipment and shut off fluorescent lights. 2. Verify that all ground cables are secure. 3. Replace monitor.
Black spots appear on screen (burnt phosphors)	Replace monitor.

Macintosh Color Display

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Exploded View

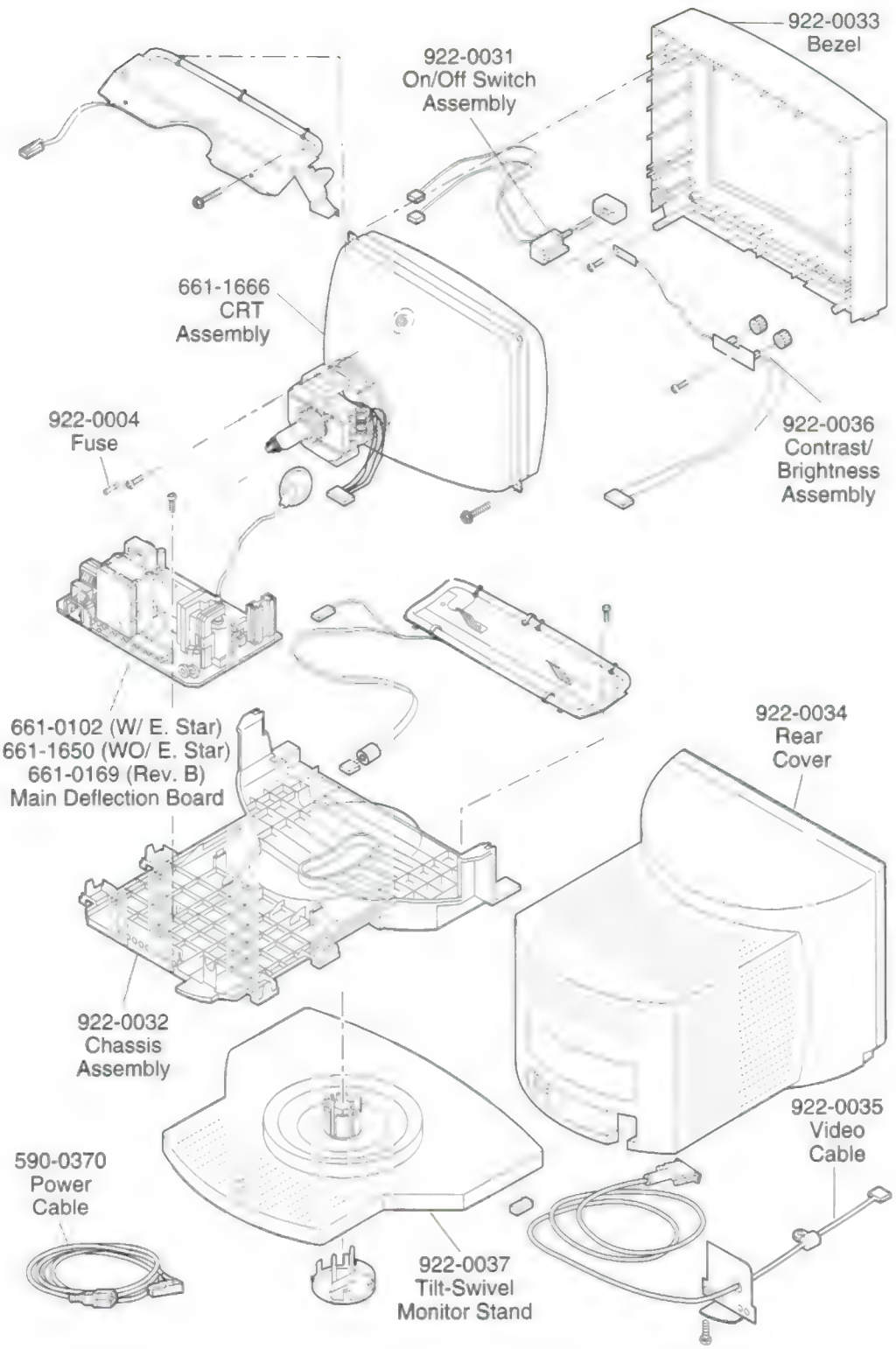


Figure 53. Macintosh Color Display Exploded View

Main Circuit Board

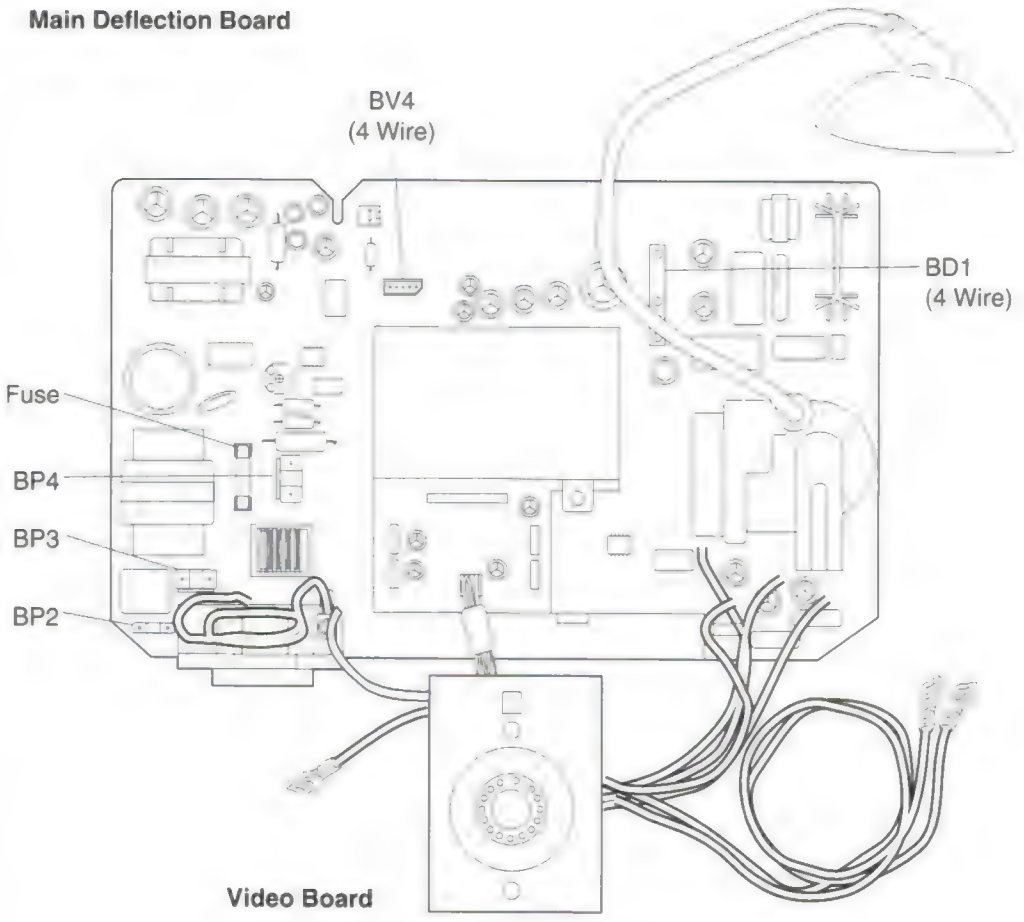


Figure 54. Macintosh Color Display Main Deflection Board

Parts List

Adjustments, Macintosh Color Display	011-0440
Bezel (with Contrast/Brightness/LED Assembly)	922-0033
Board, Main Deflection, with E. Star Compliance[1]	661-0102
Board, Main Deflection, w/o E. Star Compliance[2]	661-1650
Board, Main Deflection, Rev. B, with E. Star Compliance[3]	661-0169
Cable, Video	922-0035
Chassis Assembly	922-0032
Contrast Brightness/LED Assembly	922-0036
CRT Assembly, Australian	661-1667
CRT Assembly, Domestic	661-1666
CRT Assembly, European	661-166
Facilitation Warranty Reimbursement, Per Repair	011-0083
Fuse, Slo Blo, 3.15A (Pkg. of 5)	922-0004
Label, Rear Cover, Product I.D.	825-0493
On Off Switch Assembly	922-0031
Power Cable, AC 110 V, Smoke (1M)	590-0370
Power Cable, AC 220 V, Smoke (1M)	590-0420
Rear Cover, Plastic	922-0034
Screw/Knob Set	076-1020
Tilt-Swivel Monitor Stand	922-0037

1. Identify 661-0102 board by its RP20 board marking located near the bar code label.
2. Distinguish 661-1650 from 661-0169 and 661-0102 by the following: 661-0169 has a two-prong (BP5) connector located near the bar code label; 661-0102 has an RP20 board marking located near the bar code label, but no RP20 resistor is present; and 661-1650 has neither a two-prong (BP5) connector nor an RP20 board marking.
3. Identify 661-0169 by its PR19 (or RF19) resistor and its two-prong (BP5) connector, both located near the bar code label. This board is used in two different monitors: the Apple Audio Vision 14 Display and the Macintosh Color Display. Replace this board based on the monitor model it comes from:

   For Apple AudioVision 14 Displays, order like-for-like when replacing main deflection boards. This board cannot be replaced by the original version of the main deflection board (661-1699). For this display model, the BP5 connector is used for audio connection.

   For Macintosh Color Displays, order like-for-like when replacing main deflection boards. This board cannot be replaced by the original version of the main deflection board (661-1699). For this display model, the two-prong (BP5) connector is not used.

Troubleshooting

Symptom/Cure Chart

Use the following symptom/cure chart as a troubleshooting guide. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see Chapter 1, "General Monitor Information."

No Raster	Solution
No raster, LED off	1. Check power cable connections and power switch. 2. Check all connections on main board. 3. Replace blown fuse. 4. Replace main board.
No raster, LED on, CRT filament on	1. Adjust contrast and brightness knobs. 2. Connect known-good monitor and verify that built-in video signal or video card is working properly. 3. Check all connections on main board. Verify that video connector is secure and wires are inside plastic connector. 4. Perform video adjustments. Refer to "Video" in "Adjustments" section. 5. Replace main board. 6. Replace CRT.

Geometry	Solution
Raster too short, tall, narrow, or wide	1. Adjust vertical or horizontal size controls. Refer to "Geometry" in "Adjustments" section. 2. Replace main board.
Raster not centered	1. Move unit away from monitors, fluorescent lights, or other electrical equipment. 2. Adjust vertical or horizontal center controls. Refer to "Geometry" in "Adjustments" section. 3. Replace main board.
Horizontal linearity bad (size of text differs at sides of screen)	Replace main board.
Vertical linearity bad (size of text differs at top versus bottom of screen)	Replace main board.

Abnormal or distorted raster	1. Move unit away from monitors, fluorescent lights, or other electrical equipment. 2. Perform geometry adjustments. Refer to "Geometry" in "Adjustments" section. 3. Replace main board. 4. Replace CRT (rarely required).
Entire raster is tilted	1. Move unit away from monitors, fluorescent lights, or other electrical equipment. 2. Perform geometry adjustments. Refer to "Geometry" in "Adjustments" section. 3. Perform yoke adjustments. Refer to "Yoke" in "Adjustments" section. 4. Replace main board.

Synchronization	**Solution**
Picture breaks into diagonal lines	1. Connect known-good monitor and verify that built-in video signal or video card is working properly. 2. Replace main board.
Picture rolls vertically	1. Connect known-good monitor and verify that built-in video signal or video card is working properly. 2. Replace main board.
Picture breaks and rolls horizontally	1. Connect known-good monitor and verify that built-in video signal or video card is working properly. 2. Replace main board.
Black raster with single vertical or horizontal line	1. Replace main board. 2. Replace CRT.

Video	**Solution**
Raster too dark, too bright, or washed out	1. Adjust external contrast and brightness controls. 2. Connect known-good monitor and verify that built-in video signal or video card is working properly. 3. Perform video adjustments. Refer to "Video" in "Adjustments" section. 4. Replace main board. 5. Replace CRT (rarely required).

Out of focus	1. Perform focus adjustment. Refer to "Video" in "Adjustments" section. 2. Replace main board. 3. Adjust focus controls to their limits. If bad focus remains on one part of display, replace CRT.
Predominant color tint	1. Check video card in computer. 2. Perform video adjustments. Refer to "Video" in "Adjustments" section. 3. Replace main board. 4. Replace CRT (if you cannot eliminate red, green, or blue tint).
Out of convergence (color bleeding out from text or lines)	1. Connect known-good monitor and verify that built-in video signal or video card is working properly. 2. Perform convergence adjustments. Refer to "Video" in "Adjustments" section. 3. Replace main board. 4. Replace CRT.

Miscellaneous	**Solution**
Picture jitters or flashes	1. Move unit away from monitors, fluorescent lights, or other electrical equipment. 2. Check that all ground cables are secure. 3. Replace main board.
Intermittently shuts down	Replace main board.
Flashing or wavy screen	Replace main board.
Black screen spots (burnt phosphors)	Replace CRT.
Monitor emits high-pitched noise	Replace main board.
Does not degauss	Replace main board.
Erratic or no communication with ADB device	Replace keyboard cable, keyboard, mouse, or other ADB device.

Adjustments

▲ Warning **This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review the CRT safety rules in Chapter 1, "General Monitor Information."**

Geometry

Note Reference the "Video Adjustments Foldout," Figure 55, when performing all Geometry and Video adjustments. Unfold Figure 55 so the graphic is visible while making adjustments.

The controls on this monitor require a small hex-head plastic tool to make adjustments. If the tool is long, it will be too flexible, which will make fine adjustments difficult. Use a short hex-head plastic tool to minimize flexing.

▲ Warning **Do not use metal alignment tools because they are a shock hazard.**

Vertical Center

1. Use Display Service Utility to display the All-White Screen test pattern.
2. Using a hex-head plastic adjustment tool, adjust the vertical center control (see Figure 55A) until the raster is centered (top to bottom) in the display area.

Horizontal Center

1. Use Display Service Utility to display the All-White Screen test pattern.
2. Using a hex-head plastic adjustment tool, adjust the horizontal center control (see Figure 55A) until the raster is centered (side to side) in the display area.

Vertical Size

1. Using a hex-head plastic adjustment tool, adjust the vertical height control (see Figure 55A) until the raster height is 7 in. (± 1/8 in.) or 176 mm (± 2 mm).
2. Verify this height. If it is off, repeat the vertical size adjustment and, if necessary, the vertical center adjustment.

Horizontal Size

Using a hex-head plastic adjustment tool, adjust the horizontal width control (see Figure 55A) until the raster is 9 1/4 in. (± 1/8 in.) or 235 mm (± 2 mm).

Focus

1. Use Display Service Utility to display the Focus test pattern.
2. Using a hex-head plastic adjustment tool, adjust the focus control (see Figure 55B) until the Focus test pattern is as clear as possible.

Video

▲ Warning **This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review the CRT safety rules in Chapter 1, "General Monitor Information."**

Cutoff

Note Perform the Cutoff adjustment

- Prior to adjusting the White Balance
- After the monitor has been on for at least 10 minutes
- Whenever you replace the CRT assembly or the main board.

1. Use Display Service Utility to display the Gray Bars test pattern.
2. Set the contrast control (see Figure 55C) to maximum (clockwise) and the brightness control (see Figure 55C) to the center (detent) position.
3. Using a hex-head plastic adjustment tool, set the red, green, and blue background controls (see Figure 55A) to the full counter-clockwise positions.

Note To set the green and blue drive controls (see Figure 55A) to their 3/4 position, turn the controls to their full clockwise position, and then turn back 1/4 turn counterclockwise.

4. Set the green and blue drive controls clockwise to their 3/4 position.
5. Set the sub-contrast control (see Figure 55A) to its full clockwise position.
6. Using a hex-head plastic adjustment tool, adjust G2 (see Figure 55B) until the first bar in the test pattern is completely black and the second bar is barely visible.
7. Set the sub-contrast control to the center position.

White Balance

Note Perform the White Balance adjustment after the monitor has been on for at least 10 minutes.

1. Use Display Service Utility to display the Gray Bars test pattern.
2. Set the contrast control (clockwise) to maximum and the brightness control to the center (detent) position (see Figure 55C).
3. Note the predominant color.
4. Using a hex-head plastic adjustment tool, alternately adjust the red, green, and blue background controls (see Figure 55A) until no predominant color appears in the four darkest bars.

Note The darkest bar must remain completely black throughout the remainder of the procedure. If you notice a predominant color in the darkest bar, readjust the appropriate background control.

5. If necessary, adjust the blue and green drive controls (see Figure 55A) until no predominant color appears in the four brightest bars.
6. Check the four darkest bars, and if necessary, adjust the red, green, and blue background controls until no predominant color.

Important Readings from light meter Model L-248 and Model 246 differ. Note which meter you are using before making adjustments. (See the section, "Light Meter Setup," in Chapter 1.)

7. Using Display Service Utility, display the All-White Screen test pattern.
8. Using the light meter and a two-inch plastic screwdriver, adjust the sub-contrast control (see Figure 55A) until you get 30 foot lamberts (± 3 foot lamberts), which on the light meter is
   - Model L-248: middle of the 10 scale
   - Model 246: 23 on the red scale

Important Over time, light meter tolerances can vary. If you doubt your meter's accuracy, verify the readings with a known-good light meter or photometer.

Convergence

1. Use Display Service Utility to display the Crosshatch I test pattern.
2. Using a hex-head plastic adjustment tool, adjust the convergence control (see Figure 55D) on the CRT video board for best overall convergence.
3. Using a hex-head plastic adjustment tool, adjust the N/S amp control (see Figure 55E) for best convergence of horizontal lines at the top and bottom of the screen.
4. Adjust the lower convergence control (see Figure 55E) for best convergence of vertical lines at the bottom of the screen.
5. Adjust the upper convergence control (see Figure 55E) for best convergence of vertical lines at the top of the screen.

Geometric Distortion

Note Perform the following geometric adjustments only if your attempts to adjust raster distortions with the external geometry controls do not produce the results you wanted.

1. Use Display Service Utility to display the Crosshatch I test pattern.
2. Verify that the boxes (on the test pattern) on the top row are the same size as the boxes on the bottom row, and the boxes on the left side are the same size as the boxes on the right side.

▲ Warning **The entire yoke assembly has very high voltage. To prevent electrical shock, do not touch the yoke assembly, the anode wire, or the yoke wires.**

3. To determine which control to adjust, compare the display with the geometry distortions shown in Figure 55A.
4. Using a hex-head plastic adjustment tool, adjust the control that is appropriate for the distortion.

Note If the display is so distorted that you can't tell which adjustments to make, perform the adjustments in the following sequence:

- Pin Phase
- Vertical Angle
- Horizontal Bow

5. If the display is still distorted, repeat the vertical angle and pin phase adjustments.
6. If you can't correct the distortion, replace the main board.

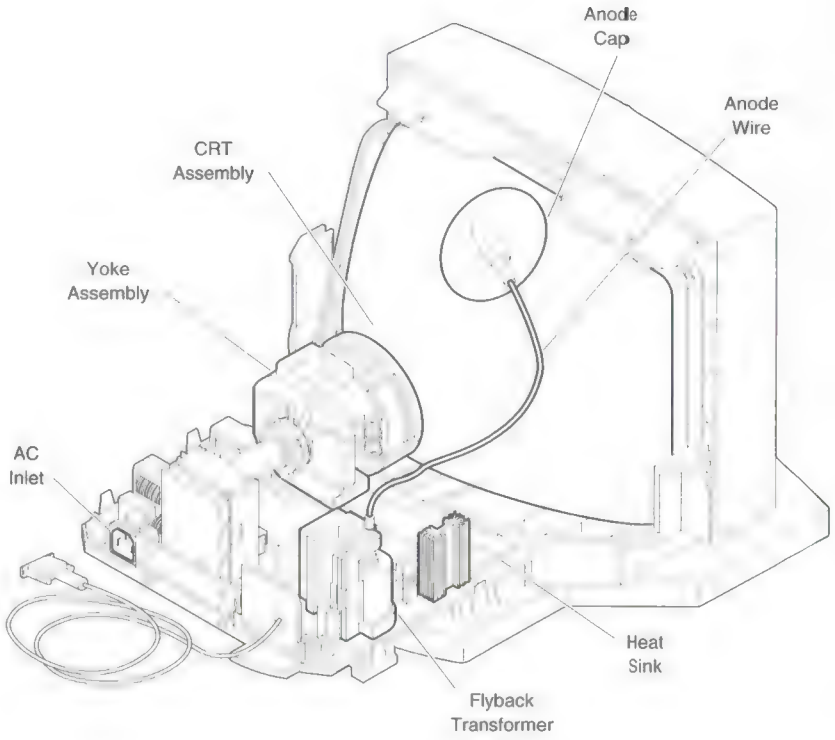
Yoke

▲ Warning **Because you must make yoke adjustments from the rear of the computer, use a mirror to view the computer screen. Do not reach around the computer to make adjustments.**

1. Using an insulated Phillips screwdriver, loosen the yoke clamp screw (see Figure 55F) two or three turns.
2. Switch on the computer.
3. With one hand, grasp the plastic yoke collar and rotate it until the top and bottom edges of the picture are parallel with the top and bottom of the bezel.
4. Switch off and unplug the computer.
5. Discharge the CRT.
6. Hold the plastic yoke collar in position and carefully tighten the yoke clamp screw so that the collar cannot slip. Do not overtighten the screw.
7. Replace the rear cover and switch on the computer.
8. Verify that the top and bottom edges of the picture are parallel with the top and bottom of the bezel.

• WARNING •

Serious Injury could result if, with the power on, you touch any of the high-voltage area shown below. Review the CRT safety rules before preforming adjustments.



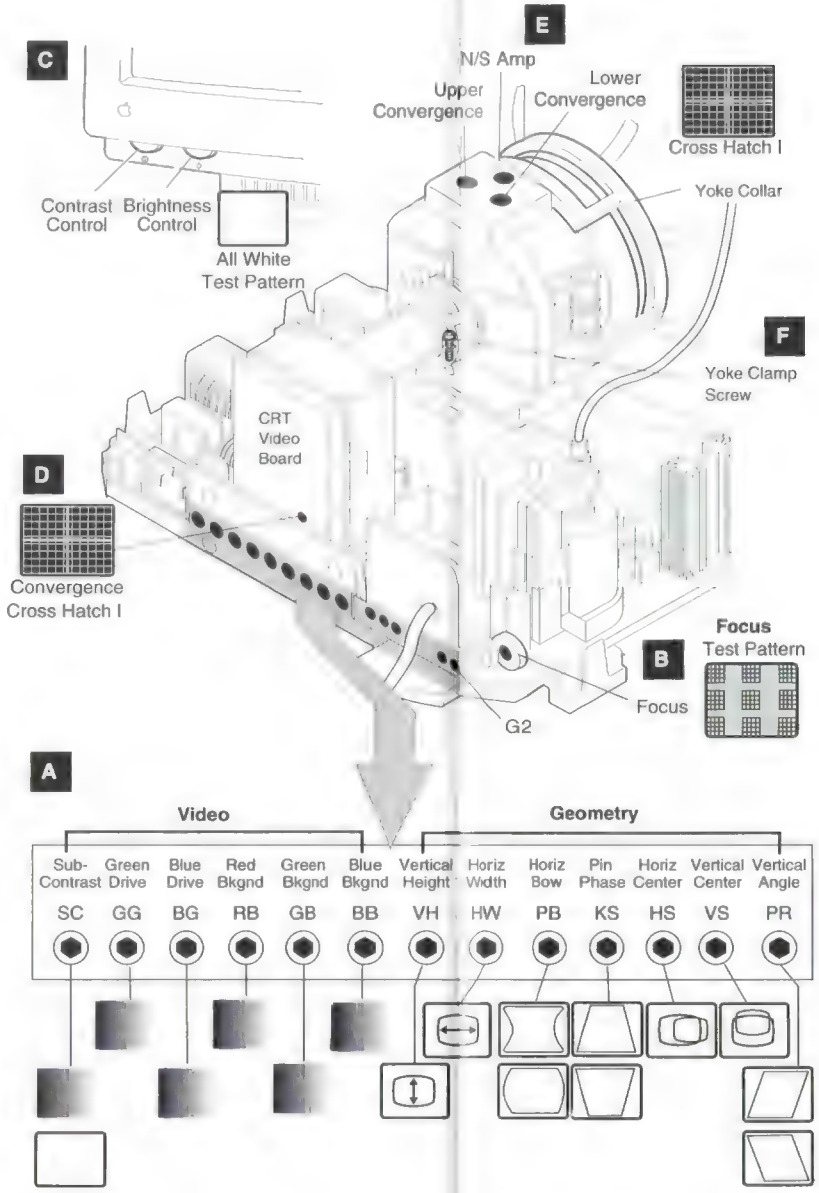


Figure 55. Macintosh Color Display Adjustments

Macintosh 16" Color Display

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Exploded View

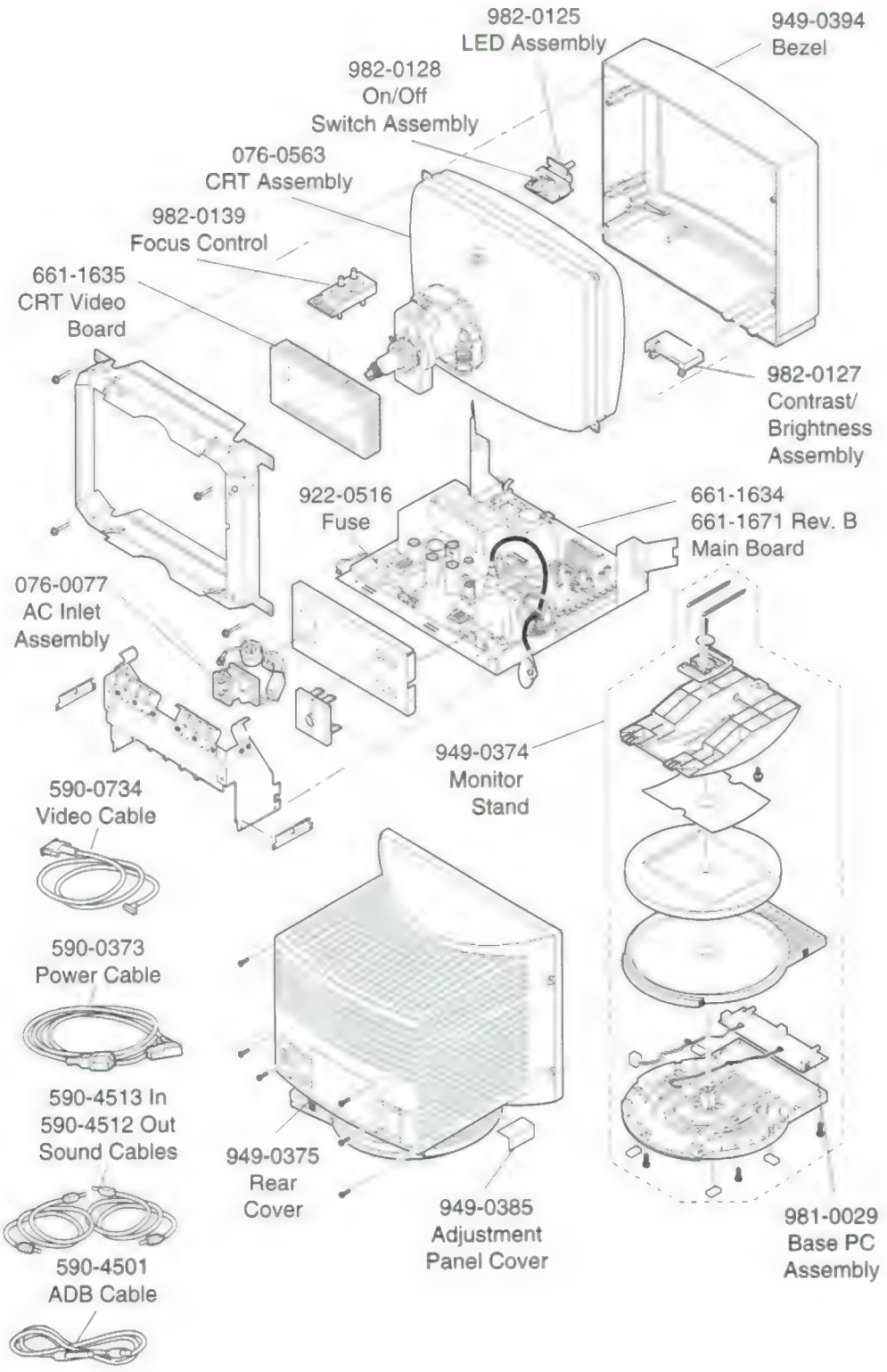
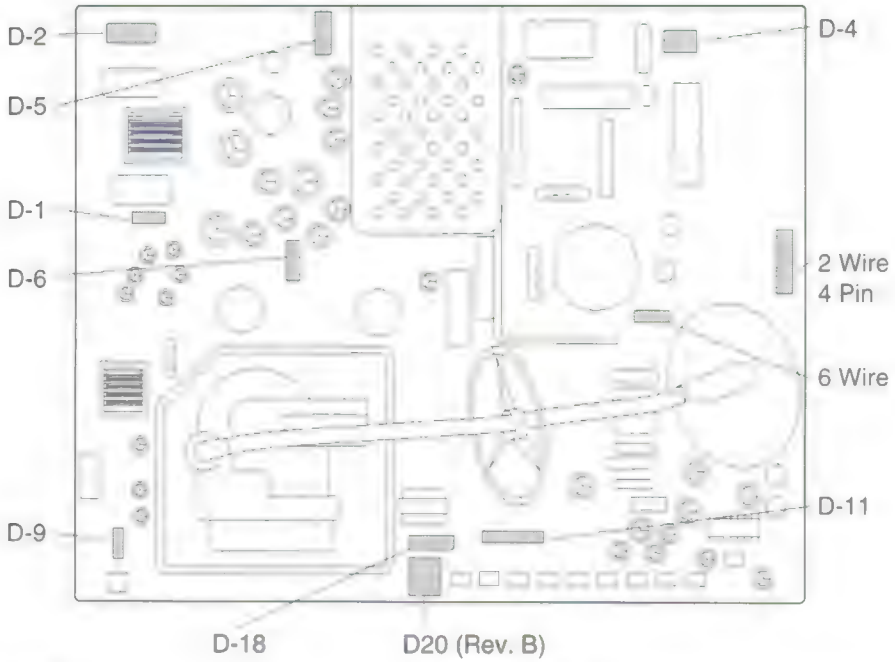


Figure 56. Macintosh 16" Color Display Exploded View

Main Deflection Board



Note: Rev. A
This module is identified by the vendor part number A-1335-028. If the vendor number is different, see Apple P/N 661-1671.

Note: Rev. B
This module is identified by the vendor part number A-1335-040 or greater. If the vendor number is A-1335-028, see Apple P/N 661-1634.

Video Board

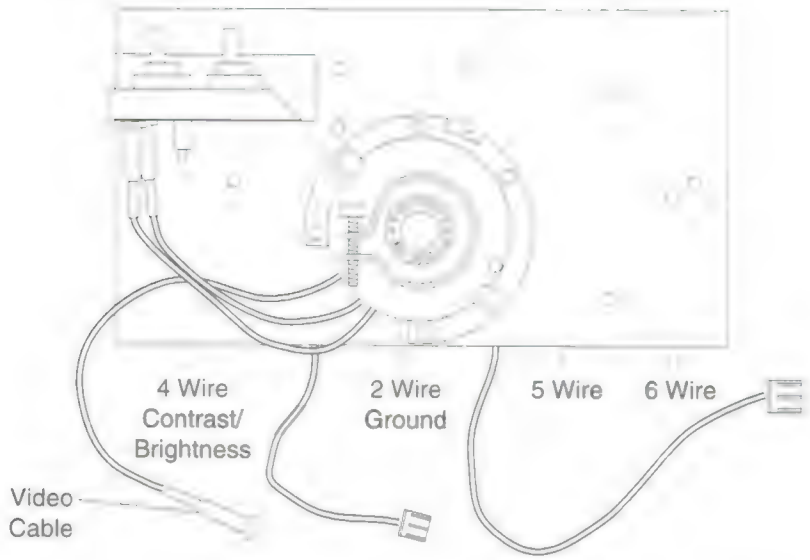


Figure 57. Macintosh 16" Color Main Circuit Boards

Parts List

Adjustment Panel Cover	949-0385
Base PC Assembly	981-0029
Bezel, Plastic Case, Rev B	949-0394
Cable Accessory Kit	076-1018
Cable, ADB, CPU/Tilt-Swivel Monitor Stand	590-4501
Cable, Sound In	590-4513
Cable, Sound Out	590-4512
Contrast/Brightness Assembly	982-0127
CRT Assembly, Anti-Glare, Anti-Static	076-0563
CRT Assembly, Anti-Glare, Rev Polarity (Australia)	076-0564
CRT Video Board	661-1635
Facilitation Warranty Reimbursement, Per Repair	011-0083
Focus H Stat Control	982-0139
Fuse, 3.15 Amp, 250 V (Pkg. of 5)	922-0516
Kit, AC Inlet Assembly	076-0077
LED Assembly with Cable	982-0125
Macintosh 16 Color Display Adjustment	011-0435
Main Deflection Board[1]	661-1634
Main Deflection Board, Rev. B[2]	661-1671
On Off Switch Assembly	982-0128
Power Cord, AC, 110 V, Smoke	590-0373
Power Cord, AC, 220 V, Smoke	590-0423
Rear Cover, Plastic	949-0375
Screw/Knob Set	076-0565
Tilt-Swivel Monitor Stand	949-0374
Video Cable, 16-Inch Display	590-0734

1. This module is identified by the vendor part number A-1335-028 appearing on the board near connector D3. If the vendor number is different, see Apple part number 661-1671.
2. This module is identified by the vendor part number A-1335-040 or greater, appearing on the board near connector D3. If the vendor number is A-1335-028, see Apple part number 661-1634.

Symptom/Cure Chart

Use the following symptom/cure chart as a troubleshooting guide. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement.

For additional assistance, contact Apple Technical Support.

No Raster	Solutions
No raster, LED off	1. Check power cord and power switch. 2. Check all main board cable connections. 3. Replace blown fuse. 4. Replace main board.
No raster, LED on, CRT filament on	1. Adjust contrast and brightness knobs. 2. Verify that video card in computer is working properly. 3. Check connectors on main board and CRT/video board. 4. Perform video adjustments. 5. Replace main board. 6. Replace CRT/video board. 7. Replace CRT.
No raster, LED on, no CRT filament, high voltage OK	1. Check connection at D5 on main board. 2. Check continuity of D5 cable from H pins on CRT socket. If bad, replace CRT/video board. 3. Replace main board.

Geometry	Solutions
Raster too short, tall, narrow, or wide	1. Adjust vertical or horizontal size controls. 2. Replace main board.
Raster not centered	1. Verify that distortion is not caused by environmental conditions. Move monitor to another location. 2. Adjust horizontal shift or vertical center controls. 3. Replace main board.
Horizontal linearity bad (size of text differs at sides of screen)	Replace main board.

Vertical linearity bad (size of text differs at top versus bottom of screen)	1. Adjust vertical linearity control. 2. Replace main board.
Abnormal or distorted raster	1. Move unit away from monitors or other electrical equipment. 2. Perform Geometry adjustments. 3. Replace main board. 4. Replace CRT.
Entire raster tilted	Move unit away from monitors or other electrical equipment.

Synchronization	**Solutions**
Picture breaks into diagonal lines	1. Connect another monitor to computer. Verify video signal. 2. Replace main board.
Picture rolls vertically	1. Verify that video card in computer is working properly. 2. Replace main board.
Picture breaks and rolls horizontally	1. Verify that video card in computer is working properly. 2. Replace main board.
Single vertical or horizontal line appears on black raster	1. Verify that CRT/video board is tight on yoke connector. 2. Replace main board. 3. Replace CRT.

Video	**Solutions**
Predominant color tint, or cannot adjust color	1. Verify that video card in computer is working properly. 2. Make sure switch SW1 on bottom of CRT/video board is toward neck of CRT. See "CRT/Video Board" in the Take Apart chapter or the *Service Source CD* for additional information. 3. Perform Video adjustments. 4. Replace CRT/video board. 5. Replace CRT (if you cannot eliminate red, green, or blue tint).

Picture too dark, too bright, or washed out	1. Adjust contrast and brightness knobs. 2. Verify that video card in computer is working properly. 3. Perform video adjustments. 4. Replace CRT/video board. 5. Replace main board. 6. Replace CRT.
Out of convergence (color bleeding out from text or lines)	1. Perform Convergence adjustment. 2. Replace CRT.
Green vertical line on left side of screen	1. Make sure switch SW1 on bottom of CRT/video board is toward neck of CRT. 2. Perform video adjustments. 3. Replace CRT/video board. 4. Replace CRT (if you cannot eliminate red, green, or blue tint).
Out of focus	1. Perform Focus adjustment. 2. Replace CRT. 3. Replace main board. 4. Replace focus control.

Miscellaneous	**Solutions**
Intermittently shuts down	Replace main board.
Picture jitters or flashes	1. Check all ground cable connections. 2. Verify that adjacent computer equipment is properly grounded. 3. Move electrical devices away from monitor. Shut off fluorescent lights near monitor. 4. Replace main board.
Flashing or wavy screen	Replace main board.
Black spots appear on screen (burnt phosphors)	Replace CRT.
Does not degauss	Replace main board.
Erratic or no communication with ADB device	1. Replace keyboard cable, keyboard, mouse, or other ADB device. 2. Replace ADB cable in monitor stand.
Emits high-pitched noise	Replace main board.

Adjustments

Module swapping cannot fix a monitor with environmental distortion problems, and adjusting a monitor with such problems alters the factory settings.

Note If the monitor has shifted up/down or right/left only, adjust it by using the centering controls. However, keep in mind that if you then move the monitor, you may need to readjust the centering controls.

Before adjusting a monitor with a distorted raster, try the following:

- Swivel or move the monitor
- Remove the monitor from the building and recheck it in another location.

Geometry

You must perform the geometry setup procedure before performing any other geometry adjustments. (Geometry adjustments are usually necessary whenever you replace the CRT or the main board.) After completing the geometry setup, go directly to the geometry adjustments (horizontal, vertical, focus, or convergence) that will fix the monitor problem.

Note Reference the "Video Adjustments Foldout," Figure 58, when performing all Geometry and Video adjustments. Unfold Figure 58 so the graphic is visible while making adjustments.

▲ Warning **This product contains very high voltages. When performing live adjustments, be careful not to touch the high-voltage components.**

Setup

1. Place monitor on level surface.
2. Remove the rear cover.
3. Switch on monitor power.
4. Let monitor warm up 15 minutes
5. Swivel the monitor so that it faces magnetic east or west.
6. Set the external brightness control to detent (midrange) and turn the contrast control clockwise to maximum contrast (see Figure 58A).
7. Use Display Service Utility to display the Crosshatch test pattern.

Horizontal

Before you begin, perform geometry setup steps.

Perform the horizontal adjustment steps in the order presented. Perform the step only if required to attain the correct alignment.

1. Using an insulated screwdriver and flexible ruler, adjust the H.SIZE control (see Figure 58B) until the width of the raster is 300 mm (± 3 mm) or 11 7/8 in. (± 1/8 in.) Straight lines may appear bent if viewed from the side. When checking screen geometry, position yourself perpendicular to and about 18 inches from the lines you are checking.
2. Using an insulated screwdriver, adjust the H.SHIFT control (see Figure 58B) until the raster is centered horizontally within the bezel.
3. Alternately, adjust the KEY and KEY BAL controls (see Figure 58B) until the sides of the raster are parallel.

   Using an insulated screwdriver, adjust the KEY control until the left and right sides of the raster are parallel to each other.

   Using an insulated screwdriver, adjust the KEY BAL control until the left and right sides of the raster are parallel to the bezel.
4. Alternately, adjust the PIN AMP and PIN BAL controls (see Figure 58B) until the sides of the raster are straight.

   Using an insulated screwdriver, adjust the PIN AMP control until the left and right sides of the raster are as straight as possible.

   Using an insulated screwdriver, adjust the PIN BAL control until the left and right sides of the raster are as straight as possible.
5. Alternately, adjust the CORNE CORR and S CORR controls (see Figure 58B) until the corners of the raster are straight.

   Using an insulated screwdriver, adjust the CORNE CORR control until the left and right sides of the raster are as straight as possible.

   Using an insulated screwdriver, adjust the S CORR control until the left and right sides of the raster are as straight as possible in the four corners of the screen.
6. Recheck and (if necessary) repeat the H.SIZE and H.SHIFT adjustments.

Vertical

Before you begin, perform geometry setup steps.

Perform the vertical adjustment steps in the order presented. Only perform the step if required to attain the correct alignment.

1. Using an insulated screwdriver and flexible ruler, adjust the V.SIZE control (see Figure 58B) until the height of the raster is 225 mm (± 3 mm) or 8 7/8 in. (± 1/8 in.). Straight lines may appear bent if viewed from the side. When checking screen geometry, position yourself perpendicular to and about 18 inches from the lines you are checking.
2. Using an insulated screwdriver, adjust the V.CENT control (see Figure 58B) until the raster is centered vertically within the bezel.
3. Using the insulated screwdriver, adjust the V.LIN control (see Figure 58B) until the rectangles at the top and bottom of the raster are the same size.
4. Recheck and (if necessary) repeat the V.SIZE and V.CENT adjustments.

Focus

Before you begin, perform geometry setup steps.

Note Be sure to check focus at display points over the entire screen.

1. Use Display Service Utility to display the Focus test pattern.
2. Using an insulated screwdriver, adjust the focus control (see Figure 58C) on the focus control board for best overall focus.

Convergence

Before you begin, perform geometry setup steps.

Important Use the H.STAT control (see Figure 58C) on the focus control board to make all convergence adjustments. Do not touch the yoke controls. With large-screen monitors it is not always possible to precisely align convergence at every point on the screen. Rather, try for the best overall alignment with the H.STAT control.

1. Use Display Service Utility to display the Crosshatch test pattern.
2. Using an insulated screwdriver, adjust the H.STAT control (see Figure 58C) on the focus control board until the red, blue, and green vertical lines are as precisely aligned as possible.

Video

Before you begin,

- Place monitor on level surface
- Switch on monitor power
- Let monitor warm up 15 minutes
- Perform necessary geometry adjustments

Important Perform the video adjustments (Cutoff and White Balance) only if the color quality is unacceptable. To determine whether the quality of the video display is acceptable, perform the steps in the following section, "Checking Display Video."

Checking Display Video

1. Set the external brightness control to detent (midrange) and turn the contrast control clockwise to maximum contrast (see Figure 58A).
2. Use Display Service Utility to display the Gray Bars test pattern.
3. Verify that
   - No colored tint appears in the bars.
   - The leftmost (darkest) three bars are black, barely distinguishable from black, and dark gray, respectively.
4. If these conditions are not met, perform the Video setup and perform the video adjustments.
5. Using Display Service Utility, display the All-White Screen test pattern.

Note Each display has specific meter readings. Note which meter you are using before making adjustments. Refer to the "Light Meters" section in Chapter 1, "General Monitor Information," for more information.

6. When you measure the screen's luminance at the middle of the screen, you should get 24 foot lamberts (± 3 foot lamberts), which on the light meter is
   - Model L-248: 9 to 10 on the10-18 scale
   - Model 246: 19 on the red scale

Important If you do not get one of these readings, complete the following setup steps and then perform the video adjustments. If you doubt your meter's accuracy, verify the readings with a known-good light meter or photometer.

Setup

1. Switch off monitor power and remove the rear cover and the EMI shield.
2. Switch on the monitor and let it warm up for 15 minutes.
3. Swivel the monitor so that it faces magnetic east/west.
4. Verify that the external brightness control is set to detent (midrange) and the contrast control is turned clockwise to maximum contrast (see Figure 58A).

Cutoff

Before you begin, perform the video setup steps.

▲ Warning **This product contains very high voltages. When performing live adjustments, be careful not to touch the high-voltage components.**

Perform the cutoff adjustment steps in the order presented.

1. Use Display Service Utility to display the Gray Bars test pattern.
2. Using the fine-tipped insulated screwdriver, preset the following CRT video board controls (see Figure 58D) to the middle of the adjustment range:
   - Sub Bright
   - Sub Contrast
   - Red, Green, and Blue Drive

Note To locate midrange, turn the control clockwise and counterclockwise to its limits, and then position the control midway between these limits.

Note 3. Setting Cutoff is easier if you first dim the overhead lights.

   Using the fine-tipped insulated screwdriver, preset the Red and Blue Background controls (see Figure 58D) to minimum (turn fully clockwise).

4. Using the fine-tipped insulated screwdriver, adjust the Screen VR (RV508) control (see Figure 58C) on the main board until the first (darkest) bar is completely black. The screen should also display a predominant green tint.

Note If the first bar is black, but the screen does not have a green tint, recheck the settings made in Step 2.

White Balance

Before you begin,

- Perform video setup
- Set Cutoff

▲ Warning **This product contains very high voltages. When performing live adjustments, be careful not to touch high-voltage components.**

1. Verify that Cutoff is set before continuing. Use the Gray Bars test pattern.
2. Using the fine-tipped insulated screwdriver, slowly turn up (turn counterclockwise) the Blue Background control (see Figure 58D) until the darkest six bars display a blue-green tint.
3. Using the fine-tipped insulated screwdriver, slowly turn up (turn counterclockwise) the Red Background control (see Figure 58D) until the darkest six bars display different shades of gray.
4. Repeat the previous two steps, alternately adjusting the Blue and Red Background controls, until no colored tint appears in the bars.
5. Use Display Service Utility to display the All-White Screen test pattern.

Note Each display has specific meter readings. Note which meter you are using before making adjustments. Refer to the "Light Meters" section in Chapter 1, "General Monitor Information," for more information.

6. When you measure the screen's luminance at the middle of the screen, you should get 24 foot lamberts (± 3 foot lamberts), which on the light meter is
   - Model L-248: 9 to 10 on the 10–18 scale
   - Model 246: 19 on the red scale

Note If you get the correct light meter reading, no predominant color appears in the Gray Bars test pattern, and the first bar is black, stop here. Otherwise, continue this procedure.

7. Perform the corrective steps for one of the following four sets of conditions. Display the Gray Bars test pattern.

Condition One

If no predominant color appears in the gray bars, but screen luminance is too high and the first bar is not completely black, adjust the Sub Bright control (see Figure 58D) slightly until the first bar is black.

Condition Two

If no predominant color appears in the gray bars and the first bar is completely black, but screen luminance is too high,

1. Alternately turn the R, G, and B Drive controls (see Figure 58D) counterclockwise to reduce screen luminance, yet retain even shades of gray in the six brightest bars.
2. If necessary, adjust the Red and Blue Background controls until the six brightest bars display even shades of gray.

Condition Three

If no predominant color appears in the gray bars, but screen luminance is too low,

1. Alternately turn the R, G, and B Drive controls clockwise to increase screen luminance, yet retain even shades of gray in the six brightest bars.
2. If necessary, adjust the Red and Blue Background controls until the six brightest bars display even shades of gray.

Condition Four

If the six brightest bars have a predominant color tint,

1. Alternately adjust the R, G, and B Drive controls until no predominant color appears.
2. Select the All-White Screen test pattern and recheck screen luminance. If necessary, adjust the Sub Bright control until you get 24 foot lamberts (± 3 foot lamberts), which on the light meter is
   - Model L-248: 9 to 10 on the 10–18 scale
   - Model 246: 19 on the red scale

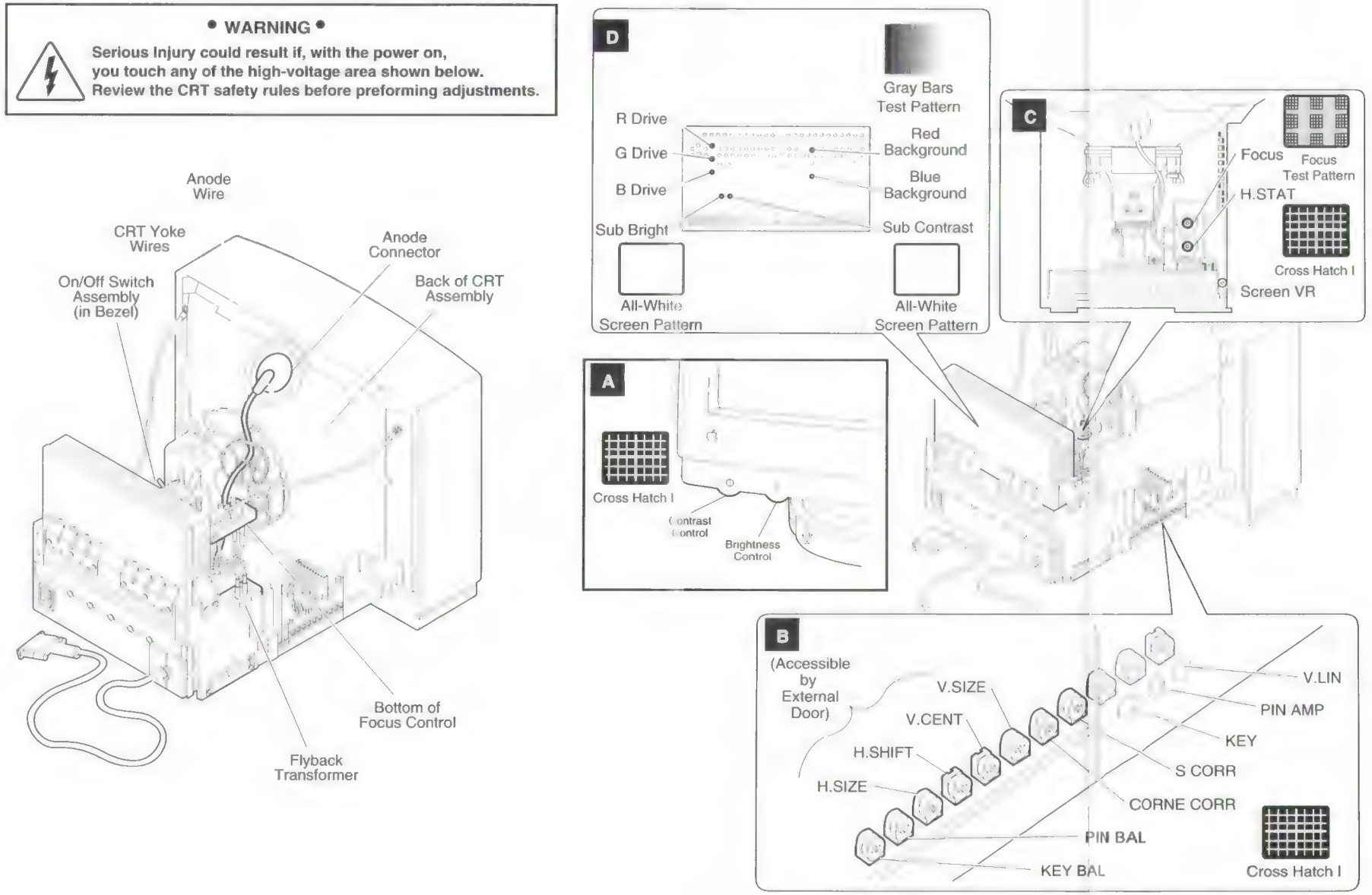


Figure 58. Macintosh 16" Color Display Adjustments

Macintosh 21" Color Display

16

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Exploded View

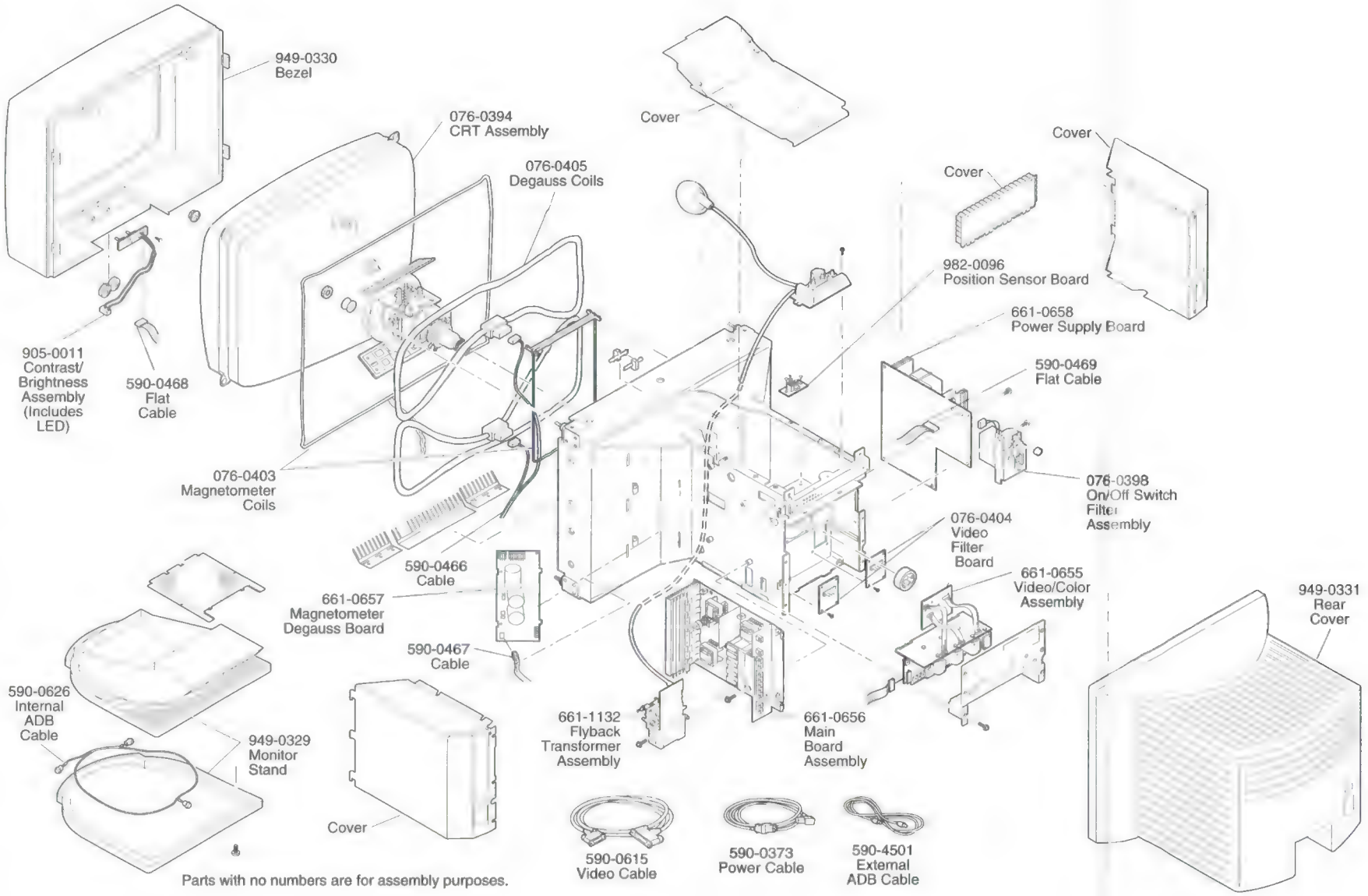


Figure 59. Macintosh 21" Color Display Exploded View

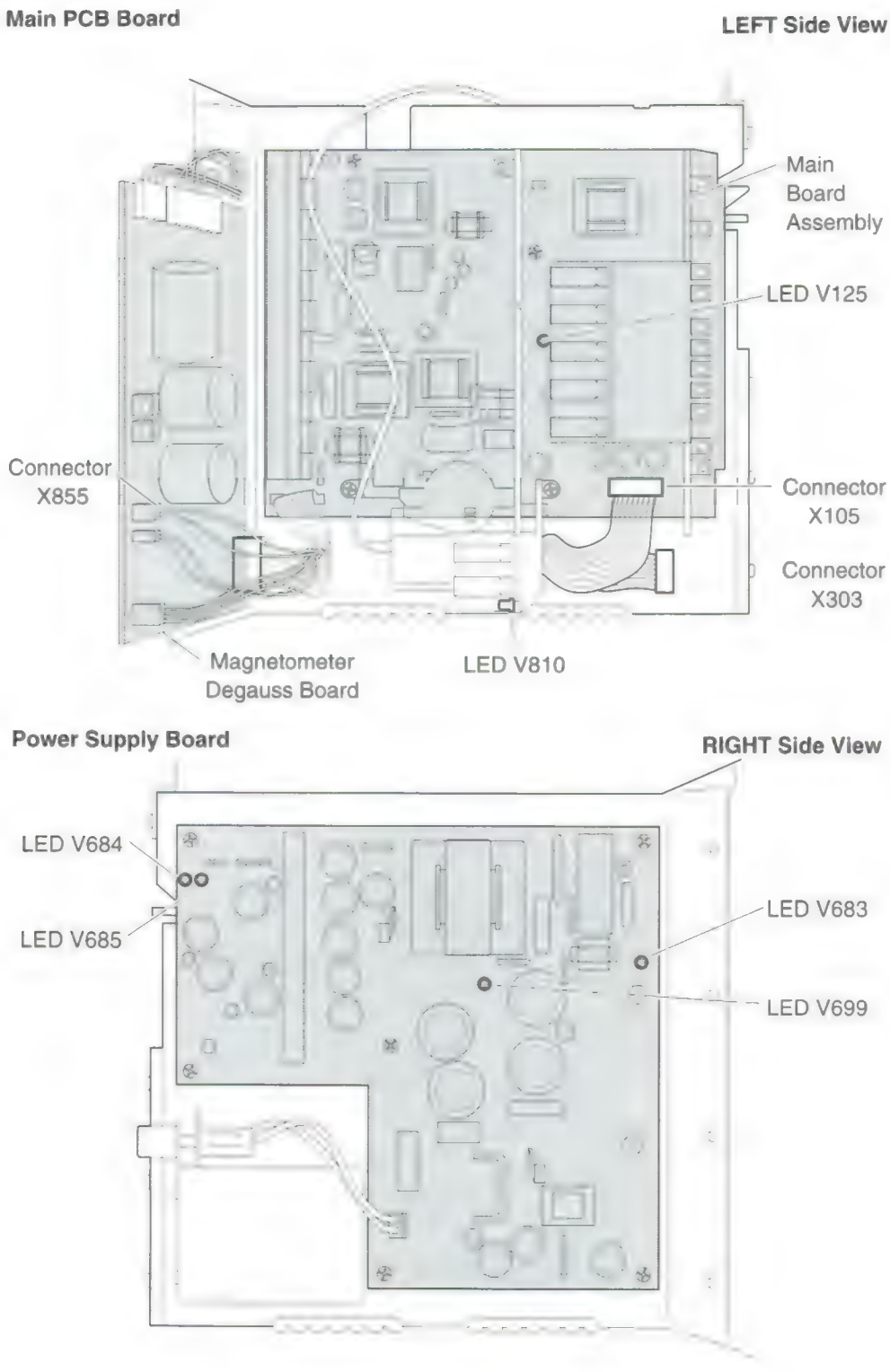


Figure 60. Macintosh 21" Color Display Main Boards

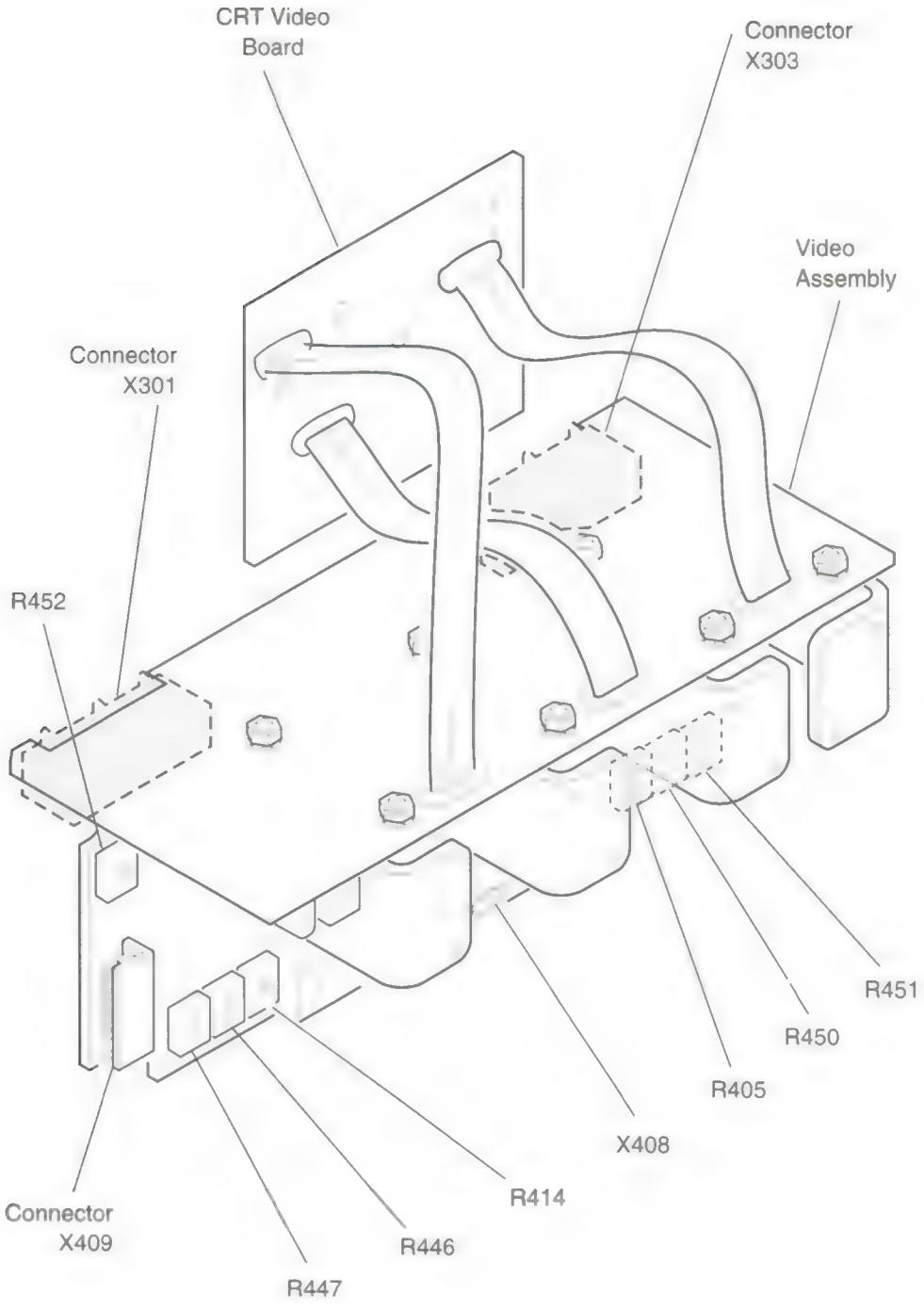


Figure 61. Macintosh 21" Color Video Assembly

Apple Macintosh Display Card 24AC	661-0432
Bezel, Plastic Case	949-0330
Cable, ADB, CPU/Tilt-Swivel Monitor Stand	590-4501
Cable, Degauss Coil/Magnatometer Degauss Board	590-0466
Cable, Flat, Brightness Control Assembly Video Filter Board	590-0468
Cable, Flat, Power Supply/Video Filter Board/Main Board	590-0469
Cable, Internal ADB, Tilt Swivel Monitor Stand	590-0626
Cable, Position Sensor/Magnatometer Degauss Board	590-0467
Cable, Video, DB15 to DB25	590-0615
CRT Assembly (International Only)	076-0394
CRT Assembly, Reversed Polarity (Australia)	076-0402
Degauss Coils, Upper/Lower	076-0405
Facilitation Warranty Reimbursement, Per Repair	011-0083
Flyback Transformer Assembly	661-1132
Label, Rear Cover, Product ID	825-2078
LED Contrast Brightness Assembly	905-0011
Macintosh 21" Color Display Adjustments	011-7111
Magnatometer Coils, Front/Rear	076-0403
Magnatometer Degauss Board	661-0657
Main Board Assembly[1]	661-0656
On/Off Switch Filter Assembly	076-0398
Position Sensor Board	982-0096
Power Cord, AC, 110 V, Smoke	590-0373
Power Cord, AC, 220 V, Smoke	590-0423
Power Supply Board	661-0658
Rear Cover, Plastic (w/o product ID label)	949-0331
Screw/Knob Set	956-0028
Tilt Swivel Monitor Stand	949-0329
Video Assembly	661-0655
Video Filter Boards, Left/Right	076-0404

1. Remove the flyback transformer assembly (P/N 076-0399) before returning the main board assembly to Apple for exchange. Refer to the Troubleshooting section to differentiate Rev. A and Rev. B main boards.

Rev A and Rev B CRT Compatibility

This procedure describes how to identify Rev A and Rev B CRTs and main boards for the Macintosh 21" Color Display. It also explains how to change a Rev B main board to a Rev A main board. See the Take Apart chapter on *Service Source CD* for complete removal procedures.

Important Rev A CRTs require Rev A main boards. Rev B CRTs require Rev B main boards.

CRT

To differentiate a Rev A CRT from a Rev B CRT, check the CRT near the anode. On Rev B CRTs you'll find a small blue label (see Figure 62) with the word "NEW" written on it.

Figure 62. Differentiate Rev A and Rev B CRTs

Differentiate Rev A and Rev B Main Boards

1. To differentiate a Rev A main board from a Rev B main board, check the board for capacitor C153 (see Figure 63). The capacitor is mounted on either the component or the solder side of Rev B boards. Rev A boards have no capacitor C153.
2. To change a Rev B main board to a Rev A main board, remove capacitor C153 from the board. (The capacitor may be on either side of the board.)

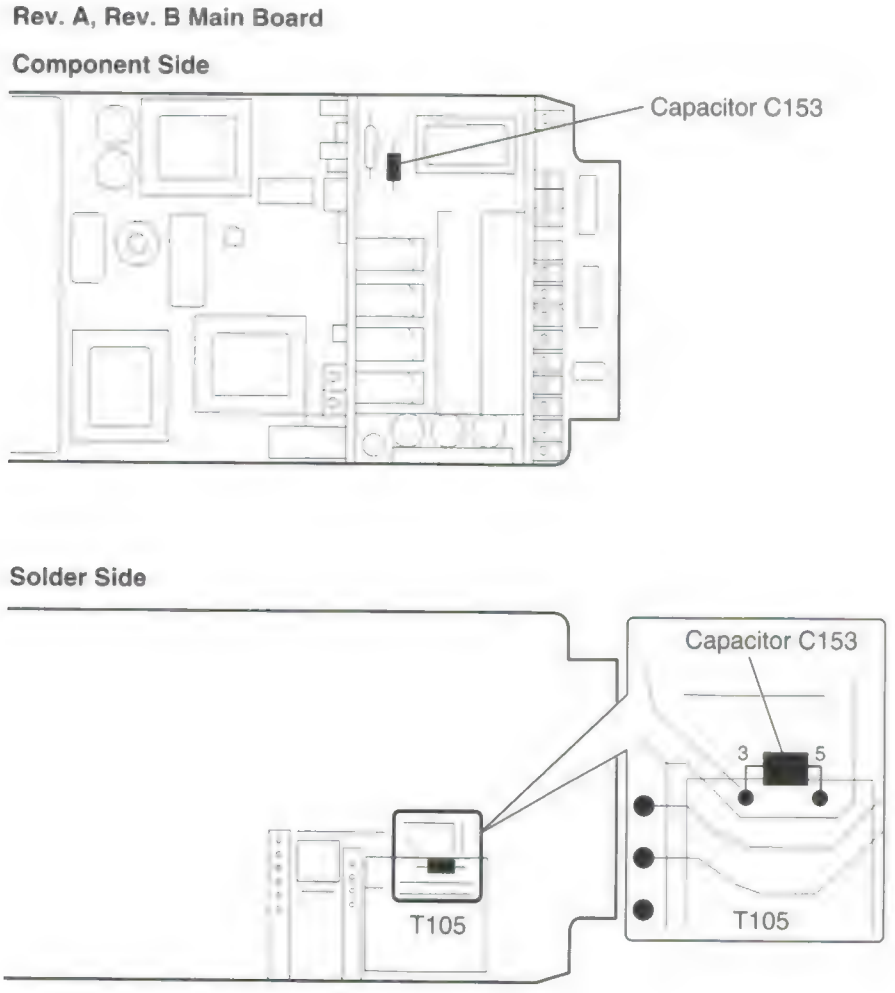


Figure 63. Differentiate Rev A and Rev B Main Boards

Troubleshooting LEDs

If you encounter a "no raster" condition, check the LEDs located on the main board and the power supply board (see Figure 60). Refer to the flowcharts in this chapter to interpret LED on/off conditions and to determine which module you should replace to correct the condition.

Main Board LEDs

LED V125 monitors the presence of horizontal and vertical sweeps. LED V810 monitors the presence of high voltage. The normal state of each LED is on. See Figure 60 for LED location.

Power Supply Board LEDs

LED V683 and LED V699 monitor the power supply board (see Figure 60). The normal state of each LED is on.

LEDs V684 and V685 monitor several conditions. The normal state of each is on (constant, not flashing). See Figure 60 for LED locations.

Symptom/Cure Chart

Use the following symptom cure chart as a troubleshooting guide. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement.

The flowcharts that follow this chart provide additional information for troubleshooting LEDs on the main board and power supply board. Use the flowcharts in conjunction with this Symptom/Cure Chart.

For additional assistance, contact Apple Technical Support.

No Raster	Solutions
No raster, LED off	1. Check power cord connection. 2. Replace power cord. 3. Check all internal power connectors. 4. Troubleshoot LEDs on power supply board and main board. Refer to "Troubleshooting LEDs" flowchart in this chapter.
No raster, LED on	1. Adjust contrast and brightness knobs. 2. Verify that video card in computer is working properly. 3. Check connectors on main board and power supply board. 4. Troubleshoot LEDs on power supply board and main board. Refer to "Troubleshooting LEDs" in this chapter.

Geometry	Solutions
Raster too short, tall, narrow, or wide	1. Adjust V-SIZE or H-SIZE controls. See "Geometry" in the "Adjustments" section of this chapter. 2. Replace main board.
Raster not centered	1. Check that distortion is not caused by environmental conditions. Move monitor. 2. Adjust H-DC SHIFT or V-SHIFT controls. 3. Replace main board. 4. Replace magnetometer degauss board.
Horizontal linearity bad (size of text differs at sides of screen)	1. Adjust H-LIN control. 2. Replace main board.

Vertical linearity bad (size of text differs at top versus bottom of screen)	1. Adjust V-LIN control. 2. Replace main board.
Raster tilted	1. Check that distortion is not caused by environmental conditions. Move monitor. 2. Perform appropriate geometry adjustments. 3. Replace magnetometer degauss board. 4. Replace position sensor board.
Abnormal or distorted raster (corners not square, sides tilted or barrel-shaped, top of display stretched or compressed)	1. Check that distortion is not caused by environmental conditions. Move monitor. 2. Check all cable connections. 3. Troubleshoot LEDs on power supply board and main board. Refer to "Troubleshooting LEDs" in this chapter. 4. Perform appropriate geometry adjustments. 5. Replace main board. 6. Replace magnetometer degauss board.

Synchronization	**Solutions**
Picture breaks into diagonal lines	1. Connect a known-good monitor to computer to verify video signal. 2. Replace main board.
Picture rolls vertically	1. Verify that video card in computer is working properly. 2. Replace main board. 3. Replace video assembly.
Picture breaks and rolls horizontally	1. Verify that video card in computer is working properly. 2. Adjust H-HOLD control. 3. Replace main board. 4. Replace video assembly.
Single vertical or horizontal line on screen	1. Verify that CRT video board is tight on yoke connector. 2. Replace main board.

Geometric Alignment	Solutions
Raster too tall or too short	Adjust V-SIZE (R52) control (see Figure 68 and Figure 69) until height is 280 mm (± 3 mm).
Raster too wide or too narrow	Adjust H-SIZE (R93) control (see Figure 68) until width is 371 mm (± 3 mm).
Raster shifted left or right	Adjust H-PHASE (R262) and H-DC SHIFT (R117) controls (see Figure 68).
Raster shifted up or down	Adjust V-SHIFT (R75) control (see Figure 68).
Rectangles at left smaller/ larger than rectangles at right	Adjust H-LIN (R101) control (see Figure 68).
Rectangles at top smaller/ larger than rectangles at bottom	Adjust V-LIN (R26) control (see Figure 68).
Raster not straight at top or bottom	Adjust N/S PHASE (R262) and N/S TRAP (R69) controls, and adjust N/S (R34) and N/S BAL (R28) controls (see Figure 68).
Center line not horizontal	Adjust N/S TILT (R74) control (see Figure 68).
Center line not straight	Adjust N/S BAL (R28) control (see Figure 68).
Raster not straight at left or right	Adjust E/W AMP (R89) control (see Figure 68).
Raster not vertical at left or right	Adjust E/W TRAP (R80) control (see Figure 68 and Figure 69).

Convergence Alignment	Solutions
Red and blue visible in vertical lines	Adjust H-STATIC control (see Figure 69B) on magnetometer degauss board.
Red and blue visible in horizontal lines	Adjust V-STATIC control (see Figure 69B) on magnetometer degauss board.
Red and blue visible in top 2 inches (50 mm) of vertical lines	Adjust VR3 yoke control (see Figure 69A).
Red and blue visible in top 1/4 inch (5 mm) of vertical lines	Adjust VR2 yoke control (see Figure 69A).

Red and blue visible in top 4 inches (100 mm) of vertical lines	Adjust VR5 yoke control (see Figure 69A).
Red and blue visible in top 2 inches (50 mm) of leftmost and rightmost vertical lines	1. Adjust AMP-T yoke control. If AMP-T doesn't correct problem, you may need to use TILT-T and AMP-T controls (see Figure 69A) interactively. 2. Adjust TILT-T yoke control. TILT-T affects lines at top-left side of screen more than lines at top-right side of screen.
Red and blue visible in bottom 2 inches (50 mm) of vertical lines	Adjust VR4 yoke control (see Figure 69A).
Red and blue visible in bottom 4 inches (100 mm) of vertical lines	Adjust VR6 yoke control (see Figure 69A).
Red and blue visible in bottom 2 inches (50 mm) of leftmost and rightmost vertical lines	1. Adjust AMP-B yoke control. If AMP-B doesn't correct problem, you may need to use TILT-B and AMP-B controls interactively (see Figure 69A). 2. Adjust TILT-B yoke control. TILT-B affects lines at bottom-left side of screen more than lines at bottom-right side of screen.
Red and blue visible in vertical lines at left and right edges of screen	1. Adjust H-RIGHT yoke control. If H-RIGHT doesn't correct problem, you may need to use H-LEFT1 and H-RIGHT controls (see Figure 69A) interactively. 2. Adjust H-LEFT1 yoke control. H-LEFT1 affects vertical lines at left edge of screen more than vertical lines at right edge of screen.
Red and blue visible in vertical lines 3-5 inches (75-125 mm) from left and right edges of screen	Adjust H-LEFT2 yoke control (see Figure 69A).
Red and blue visible in vertical lines on left third of screen	Adjust 1/2W yoke control (see Figure 69A).
Red and blue visible in horizontal lines at top and bottom edges of screen	1. Adjust V-NS yoke control. If V-NS doesn't correct problem, you may need to use V-NS and V-N controls interactively (see Figure 69C). 2. Adjust V-N yoke control (see Figure 69C).

Red and blue are visible in centermost horizontal lines at left and right edges of screen	Adjust V-EW yoke control (see Figure 69C).
Red and blue visible at left edge of center horizontal line	Adjust V-W yoke control (see Figure 69C).

Video	Solutions
Predominant red, blue, or green tint	1. Verify that video card in computer is working properly. 2. Perform video adjustments. 3. Replace video assembly. 4. Replace video filter boards. 5. Domestic: Call Apple Technical Support to confirm a CRT failure. International: Replace CRT
Picture too dark or too bright	1. Adjust contrast and brightness knobs. 2. Verify that video card in computer is working properly. 3. Perform video adjustments. 4. Replace power supply board. 5. Replace video assembly. 6. Replace video filter boards. 7. Domestic: Call Apple Technical Support to confirm a CRT failure. International: Replace CRT.
Out of focus	1. Adjust focus controls. 2. Replace flyback transformer assembly. 3. Replace main board. 4. Domestic: Call Apple Technical Support to confirm a CRT failure. International: Replace CRT.
Out of convergence (color bleeding out from text or lines)	1. Verify that video card in computer is working properly. 2. Check Convergence Alignment symptom chart and perform appropriate adjustment. 3. Perform convergence adjustments. 4. Domestic: Call Apple Technical Support to confirm a CRT failure. International: Replace CRT.

Miscellaneous	Solutions
Intermittently shuts down	1. Replace flyback transformer assembly. 2. Replace main board.
Picture jitters or flashes	1. Check all ground cable connections. 2. Verify that adjacent computer equipment is properly grounded. 3. Move electrical devices away from monitor and shut off fluorescent lights. 4. Replace main board.
Screen has black spots (burnt phosphors)	Domestic: Call Apple Technical Support to confirm a CRT failure. International only: Replace CRT.
Monitor emits high-pitched noise	Replace flyback transformer assembly.
Does not degauss	1. Replace magnetometer degauss board. 2. Replace position sensor board.
No communication or erratic communication with ADB device	1. Replace keyboard, mouse, or other ADB device. 2. Replace ADB cable in monitor stand.

Troubleshooting LEDs

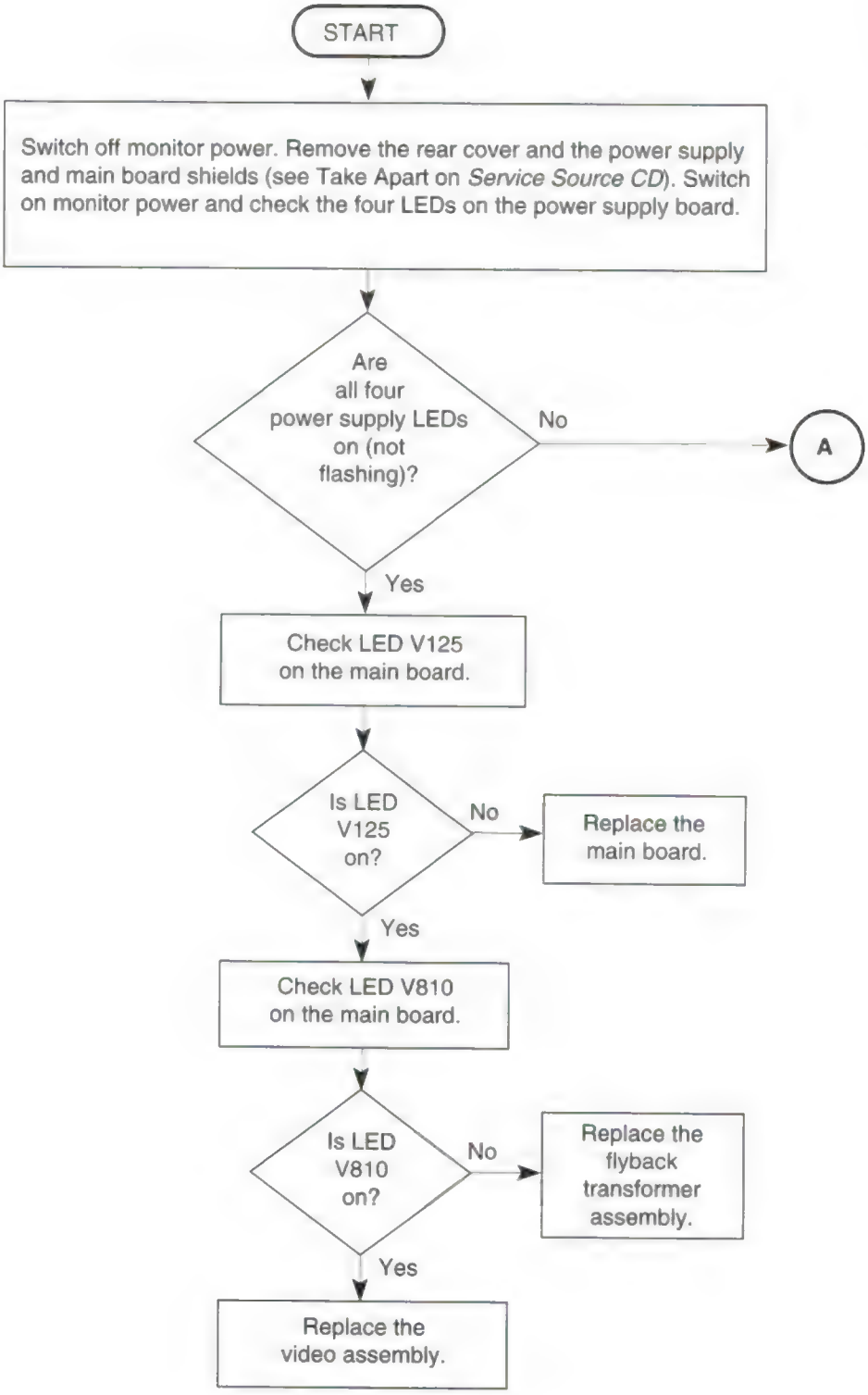


Figure 64. Troubleshooting LEDs Starting Flowchart

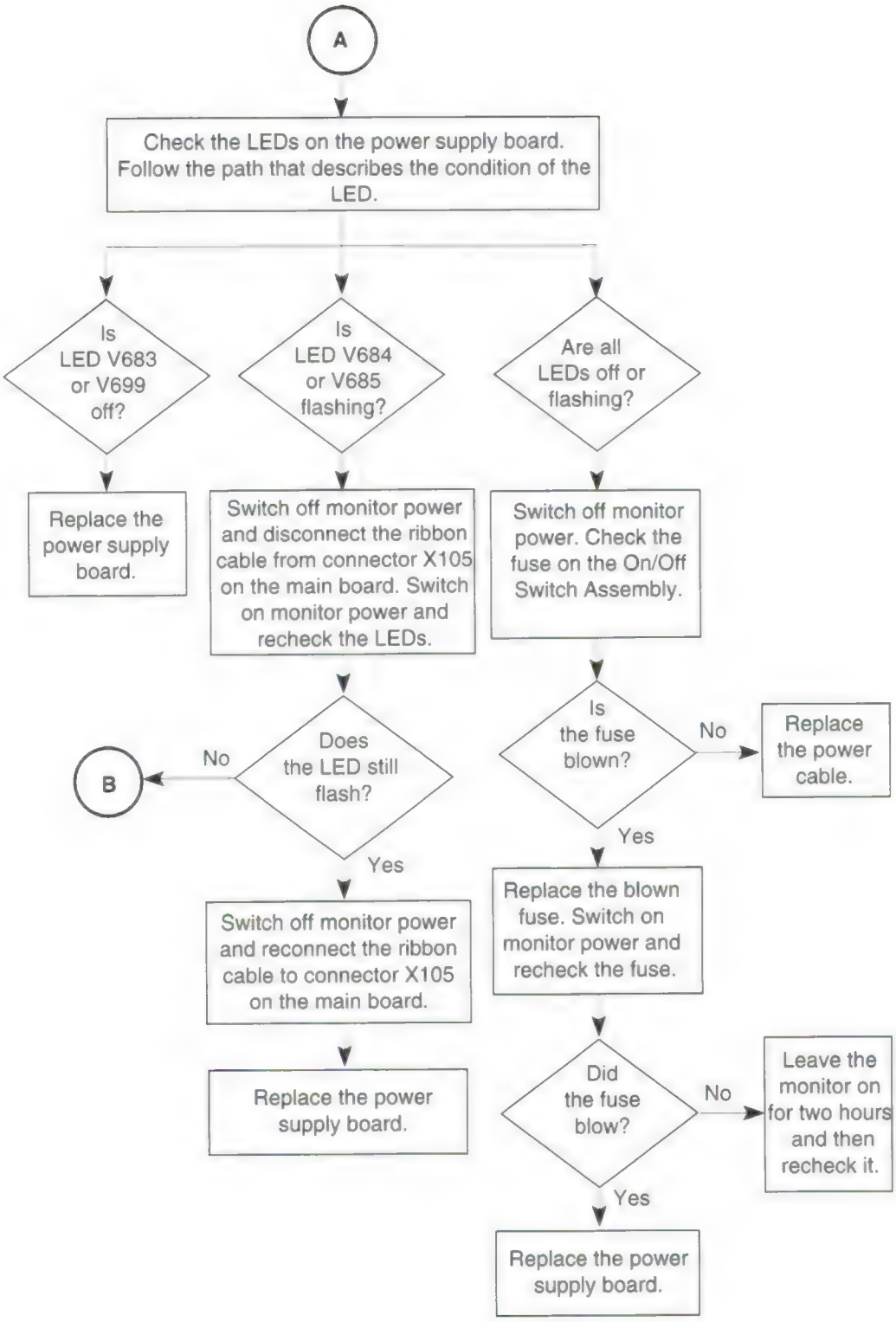


Figure 65. Troubleshooting LEDs Flowchart A

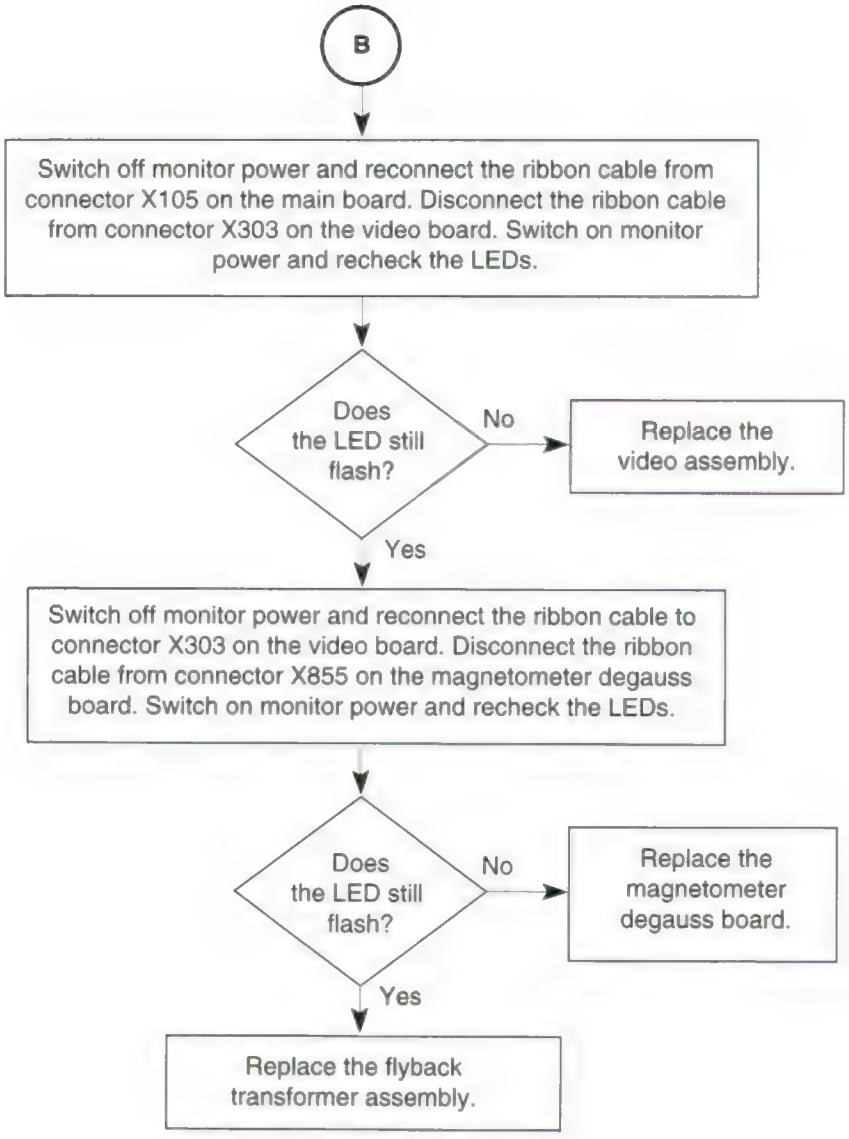


Figure 66. Troubleshooting LEDs Flowchart B

Aligning to Magnetic N/S

Sensitive components inside the display (especially the degaussing circuitry) require aligning the monitor to magnetic north or south before adjusting it.

1. Keep the monitor at least 3 feet from any metal objects, such as steel filing cabinets.
2. Use a compass to locate magnetic north/south on a protective pad.
3. Place the monitor on the pad in a north/south alignment (with the bezel facing north or south).
4. Place the compass on the bezel.
5. Swivel the monitor left or right until the compass needle points to North (360 degrees).

Geometry

Before you begin,

- Remove the rear cover
- Remove the main board access panel
- Turn on monitor power
- Let monitor warm up 15 minutes
- Align monitor to magnetic North/South

▲ Warning **This product contains very high voltages. When performing live adjustments, be careful not to touch high-voltage components.**

Important You must perform the geometry setup procedure before performing any other geometry adjustments. After completing the geometry setup, go directly to the geometry adjustments (horizontal and vertical, convergence, or focus) that will fix the monitor problem.

Note Reference the "Geometry Adjustments Foldout," Figure 68, when performing Geometry adjustments. Unfold Figure 68 so the graphic is visible while making adjustments.

To perform the geometry adjustments, you will need a compass, voltmeter, and diagnostic overlay (P/N 076-0444).

Because of the large size of the CRT, straight lines may appear bent. To avoid distortions, use the diagnostic overlay, take measurements with the same eye, and keep that eye directly above the point being measured.

1. Tilt the monitor up slightly and place the diagnostic overlay (see Figure 67) against the inside left and bottom edges of the bezel. Tape the overlay to the bezel. When using the diagnostic overlay, adjust your head until you see only two etched lines. These lines define the acceptable limits of the raster.

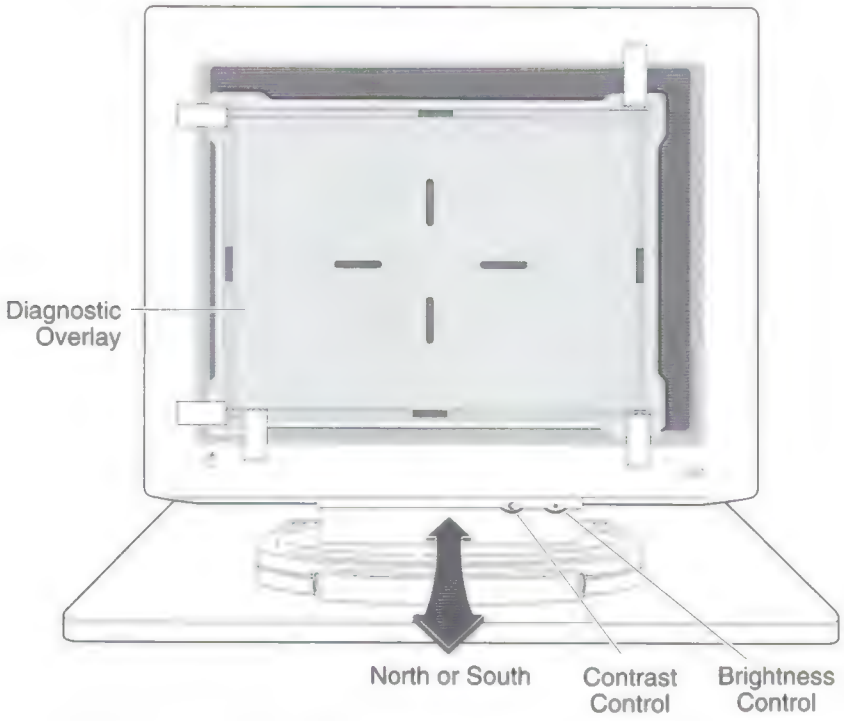


Figure 67. Diagnostic Overlay and Controls

2. Set the external brightness control (see Figure 67) to detent (midrange).
3. Turn the contrast control clockwise to maximum contrast (see Figure 67).
4. Use Display Service Utility to display the East/West Bars test pattern.

▲ Caution **Do not apply excessive pressure when adjusting the controls. The controls are mounted perpendicular to the circuit boards and can be broken easily.**

5. Using the insulated screwdriver, adjust the H-SIZE control (see Figure 68) until the raster is 371 mm (± 3 mm) or 14 11/16 in. (± 1/8 in.) wide.

6. Using Display Service Utility, display the North/South Bars.
7. Using the insulated screwdriver, adjust the V-SIZE control (see Figure 68) until the raster is 280 mm (± 3 mm) or 11 in. (± 1/8 in.) high.

Horizontal and Vertical

Before you begin, perform the geometry setup procedure.

Important Perform the horizontal and vertical adjustment steps in the order presented. Perform the step only if required to attain the correct alignment.

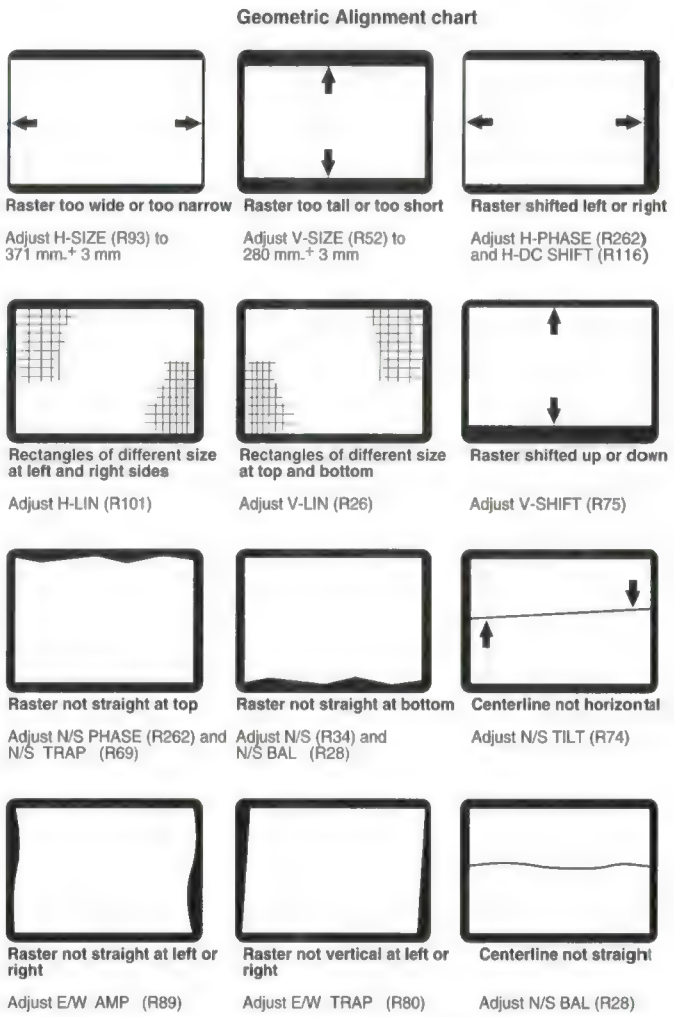
1. Using Display Service Utility, display East/West Bars.
2. Using the insulated screwdriver, adjust the H-PHASE control (see Figure 68) counterclockwise until the left bar wraps at the left edge of the screen. Turn the control back until the right bar stops. Center the control between these points.
3. Using the insulated screwdriver, adjust the H-DC SHIFT control (see Figure 68) until the left and right bars are centered in the screen.
4. Using Display Service Utility, display the Crosshatch pattern.
5. Using the linearity adjustment tool, adjust the H-LIN control (see Figure 68) until rectangles on the left and right side of the raster are the same size.
6. If necessary, readjust the H-DC SHIFT control (see Figure 68) centering the pattern in the screen.
7. Using Display Service Utility, display the North/South Bars.
8. Using the insulated screwdriver, adjust the N/S PHASE control (see Figure 68) until the top and bottom horizontal lines are as straight as possible.
9. Adjust the N/S TRAP control (see Figure 68) until the topmost and bottommost lines are parallel. (The N/S TRAP control fine-tunes the N/S PHASE control.)
10. Using Display Service Utility, display the Centerline pattern.
11. Using the insulated screwdriver, adjust the N/S TILT control (see Figure 68) until the centerline is horizontal.
12. Using Display Service Utility, display the North/South Bars.

Note In the following steps, strive for the best overall adjustment with both the N/S and N/S BAL controls.

13. Using the insulated screwdriver, adjust the N/S (amplitude) control (see Figure 68) until the top and bottom horizontal lines are as straight as possible.
14. Using the insulated screwdriver, adjust the N/S BAL control (see Figure 68) until the top and bottom horizontal lines are as straight as possible.
15. Using Display Service Utility, display the Crosshatch pattern.
16. Using the insulated screwdriver, adjust the V-LIN control (see Figure 68) until the height of the rectangles at the top and bottom of the pattern are the same size.
17. Using Display Service Utility, display North/South Bars.
18. Using the insulated screwdriver, adjust the V-SHIFT control (see Figure 68) until the top and bottom bars are positioned in the vertical center of the screen.
19. Using the insulated screwdriver, adjust the V-SIZE control (see Figure 68) until the raster is 280 mm (± 3 mm) or 11 in. (± 1/8 in.) high.
20. Using Display Service Utility, display the East/West Bars test pattern.
21. Using the insulated screwdriver, adjust the E/W TRAP control (see Figure 68) until the left and right vertical lines are straight.
22. Using the insulated screwdriver, adjust the E/W AMP control (see Figure 68) until the left and right vertical lines are parallel.
23. Using the insulated screwdriver, adjust the H-SIZE control (see Figure 68) until the raster is 371 mm (± 3 mm) or 14 11/16 in. (± 1/8 in.) high.
24. Using Display Service Utility, display the All-White Screen test pattern.

Note To adjust the H-HOLD control in the next step you must cut a plastic alignment tool to a 3-inch length.

25. For the next step, make sure the voltmeter is grounded to the monitor chassis and set to the 200 V DC setting.
26. Using a short insulated screwdriver and a voltmeter, adjust the H-HOLD control (see Figure 69B) until the voltmeter reads 4.1 volts (± 0.2 V) at TP254.
27. Remove the diagnostic overlay from the bezel.



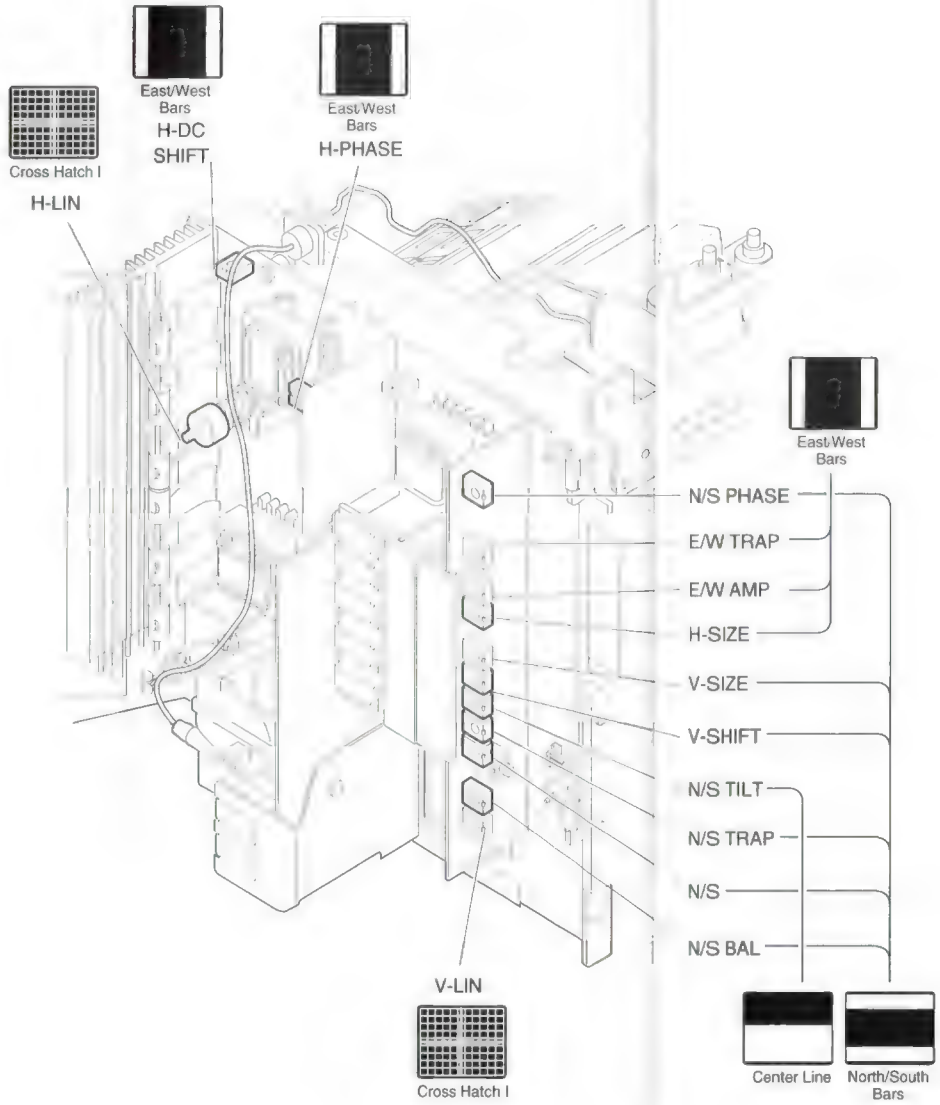


Figure 68. Macintosh 21" Color Display Geometry Adjustments

Convergence

Before you begin, perform the geometry setup procedure.

Note Reference the "Convergence Adjustments Foldout," Figure 69, when performing convergence adjustments. Unfold Figure 69 so the graphic is visible while making adjustments.

Important Some misconvergence is normal on large-screen monitors. The convergence adjustments on the yoke of the CRT are factory-adjusted and you should never have to readjust them.

Before attempting the entire convergence procedure, refer to "Convergence Alignment" symptoms in the "Symptom/Cure Chart" in the "Troubleshooting" section and try the control that best corrects the misconvergence problem.

You may not be able to precisely align convergence at every point on the screen, but strive for the best overall alignment with each convergence control. Locate the convergence controls on the yoke control board and the magnetometer degauss board.

1. Using Display Service Utility, display the Crosshair Lines test pattern.
2. Using the insulated screwdriver, adjust the following controls on the magnetometer degauss board:
   - H-STATIC control (see Figure 69B) to align the red and blue vertical lines at midscreen.
   - V-STATIC control (see Figure 69B) to align the red and blue horizontal lines at midscreen.
3. Using Display Service Utility, display the Crosshatch test pattern.
4. Recheck screen convergence. If convergence is acceptable, stop here. (The H-STATIC and V-STATIC controls correct many problems.)

▲ Warning **When removing access panels with power on, keep in mind that serious injury could result if you touch any of the high-voltage components.**

5. If convergence is not acceptable, remove the CRT access cover (see Take Apart on the *Service Source CD*) and continue the procedure.
6. Using Display Service Utility, display the Vertical Lines at Top test pattern.

7. Using the insulated screwdriver and the VR3 yoke control (see Figure 69A), align the vertical lines in the top 2 inches (50 mm).
8. Using the insulated screwdriver and the VR2 yoke control (see Figure 69A), align the vertical lines in the top 1/4 inch (5 mm).
9. Using the insulated screwdriver and the VR5 yoke control (see Figure 69A), align the vertical lines in the upper 4 inches (100 mm).

Note The AMP-T control adjusts the tops of the red and blue vertical lines equally. The TILT-T control adjusts the vertical lines at the top-left side of the screen more than at the top right. You may need to use the TILT-T control to misalign the left and right vertical lines equally, and then return to the AMP-T control to align them (see Figure 69A).

10. Using the insulated screwdriver and the AMP-T yoke control, align the top 2 inches (50 mm) of the left and right vertical lines.
11. Using the insulated screwdriver and the TILT-T yoke control, adjust the tops of the left and right vertical lines. If necessary, return to the AMP-T control.
12. Using Display Service Utility, display Vertical Lines at Bottom pattern.
13. Using the insulated screwdriver and the VR4 yoke control (see Figure 69A), align the vertical lines in the bottom 2 inches (50 mm).
14. Using the insulated screwdriver and the VR6 yoke control (see Figure 69A), align the vertical lines in the bottom 4 inches (100 mm).

Note The AMP-B control affects the bottom of the red and blue vertical lines equally; the TILT-B control affects the vertical lines at the bottom left side of the screen more than at the bottom right. You may need to use the TILT-B control to misalign the left and right vertical lines equally, and the AMP-B control to align them (see Figure 69A).

15. Using the insulated screwdriver and the AMP-B yoke control, align the bottom 2 inches (50 mm) of the vertical lines.
16. Using the insulated screwdriver and the TILT-B yoke control, adjust the bottoms of the left and right vertical lines. If necessary, return to the AMP-B control.
17. Using Display Service Utility, display Vertical Lines at Sides pattern.

Note The H-RIGHT control affects the vertical lines at the left and right sides of the screen equally; the H-LEFT1 control affects the vertical lines at the left side of the screen more than at the right. You may need to use the H-LEFT1 control to misalign the left and right vertical lines equally, and the H-RIGHT control to align them (see Figure 69A).

18. Using the hex-head adjustment tool and the H-RIGHT yoke control, align the vertical lines at the left and right sides of the screen.
19. Using the insulated screwdriver and the H-LEFT1 yoke control, adjust the vertical lines at the left and right sides of the screen. If necessary, return to the H-RIGHT control.
20. Using the hex-head adjustment tool and the H-LEFT2 yoke control, (see Figure 69A) align the vertical lines in an area 3–5 inches (75–125 mm) from the left and right edges of the screen.
21. Using the insulated screwdriver and the 1/2W yoke control (see Figure 69A), align the vertical lines on the left third of the screen.
22. Using Display Service Utility, display the Horizontal Lines at Top & Bottom test pattern.

Note The V-NS control affects the red and blue horizontal lines at the top and bottom of the screen equally. The V-N control affects the horizontal lines at the top of the screen more than at the bottom. You may need to use the V-N control to misalign the top and bottom horizontal lines equally, and the V-NS control to align them (see Figure 69C).

23. Using the insulated screwdriver and the V-NS yoke control (see Figure 69C), align the horizontal lines at the top and bottom of the screen.
24. Using the insulated screwdriver and the V-N yoke control (see Figure 69C), adjust the horizontal lines at the top and bottom of the screen. If necessary, return to the V-NS control.
25. Using Display Service Utility, display the Crosshair Lines test pattern.

Note The V-EW control (see Figure 69C) rotates the red and blue guns around an imaginary axis in the center of the screen.

26. Using the hex-head adjustment tool and the V-EW yoke control, align the centermost horizontal lines at the left and right edges of the screen.
27. Using Display Service Utility, display the Horizontal Lines at Left test pattern.
28. Using the insulated screwdriver and the V-W yoke control (see Figure 69C), align the horizontal lines at the left edge of the centerline.

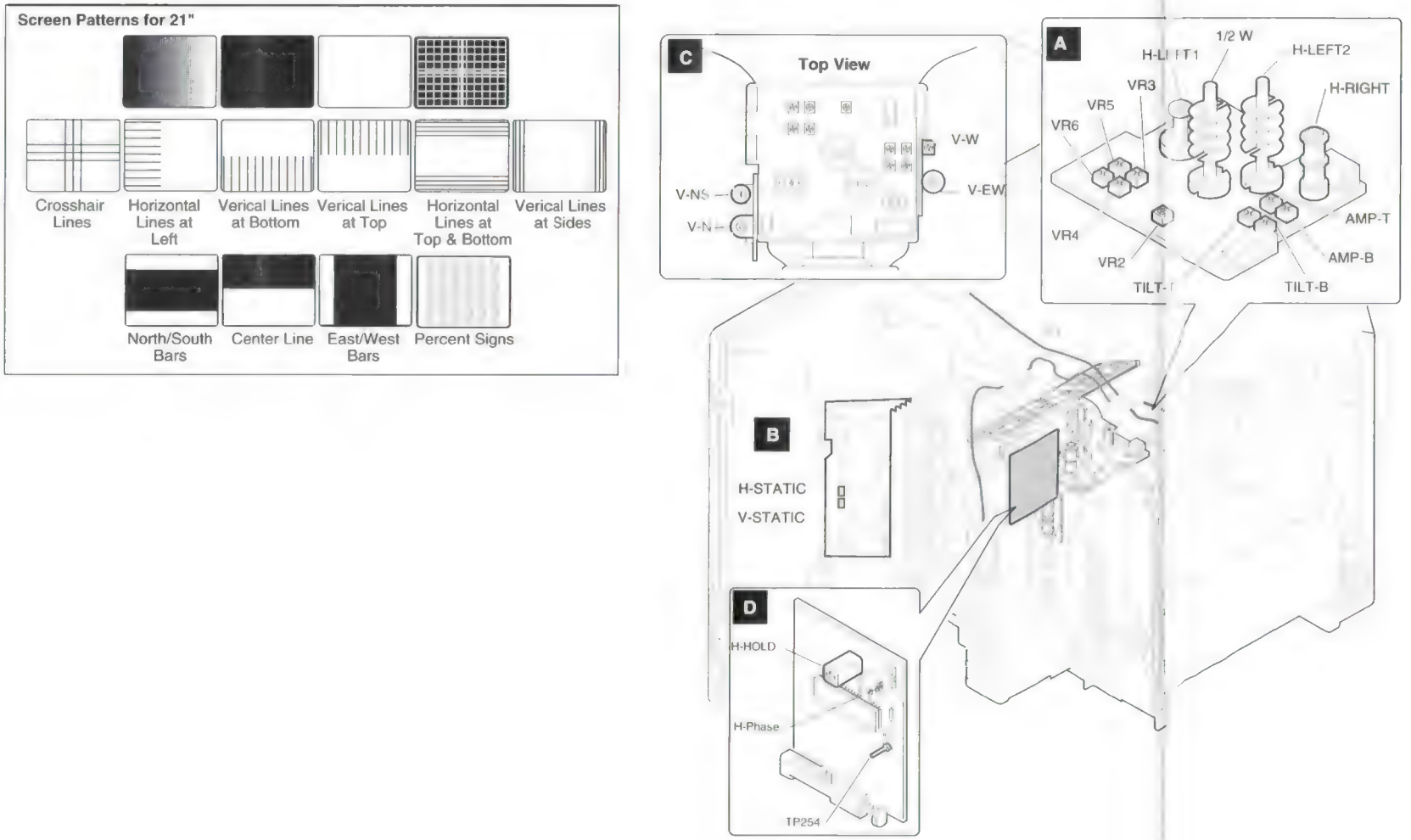


Figure 69. Macintosh 21" Color Display– Convergence Adjustments

Focus

Before you begin,

- Perform the geometry setup procedure
- Remove the CRT access cover

Note Reference the "Focus and Video Adjustments Foldout," Figure 70, when performing the Focus and Video adjustments. Unfold Figure 70 so the graphic is visible while making adjustments.

▲ Warning **When removing the access panels with power on, keep in mind that serious injury could result if you touch any of the high-voltage components.**

Note The focus controls are located on the main board and the high-voltage block.

1. Using Display Service Utility, display the Crosshatch test pattern.
2. Using the insulated screwdriver, turn the V-DYNAMIC FOCUS (R155) control (see Figure 70B) on the main board clockwise to its limit.
3. Using the insulated screwdriver, adjust the FOCUS 2 control on the high-voltage block until the center vertical line is as small as possible.
4. Using the insulated screwdriver, adjust the FOCUS 1 control on the high-voltage block until the center horizontal line is as small as possible.
5. Check whether the horizontal lines at the top and bottom of the screen are precisely focused. If not, back off (turn counterclockwise) the V-DYNAMIC FOCUS (R155) control until the horizontal lines are as small as possible.
6. Using Display Service Utility, display the Focus Adjustment test pattern, Percent Signs.
7. Using the insulated screwdriver, adjust the FOCUS 1 control (see Figure 70B). on the high-voltage block for best overall focus.

Checking Display Video

Use the following procedure to determine whether the color quality of the monitor display is acceptable. Perform video adjustments only if the color quality is unacceptable.

1. Turn on monitor power.
2. Let monitor warm up for 15 minutes.
3. Align monitor to magnetic North/South.
4. Using Display Service Utility, display the Gray Bars test pattern.
5. Set the external brightness control to its center detent position and the external contrast control to maximum contrast (turn fully clockwise).
6. Check that no colored tint appears in the gray bars.

Note

Note which meter you are using before making adjustments. Readings differ from light meter Model L-248 and Model 246. (See the section, "Light Meters" in Chapter 1, "General Monitor Information.")

7. The brightest bar should measure 27 foot lamberts (± 3 foot lamberts), which on the light meter is
   - Model L-248: low end of the 10 scale
   - Model 246: 21.5 on the red scale
8. The darkest three bars are respectively black, barely distinguishable from the black bar, and dark gray.
9. If these conditions are not met, perform the video adjustments procedure.

Video

Perform the video adjustments only if the color quality is unacceptable. Refer to the preceding topic, "Checking Display Video." To perform the video adjustments, you will need a compass, light meter (Model L-248 or Model 246), and voltmeter.

1. Remove the rear cover.
2. Remove the CRT and video board access panels.
3. Turn on monitor power.
4. Let monitor warm up for 15 minutes.
5. Align monitor to magnetic North/South.

▲ Warning **This product contains very high voltages. When performing live adjustments, be careful not to touch high-voltage components.**

6. Using Display Service Utility, display the All-Black Screen test pattern.
7. Set the external brightness control to maximum brightness (turn fully clockwise).
8. Set the external contrast control to minimum contrast (turn fully counterclockwise).
9. Using the insulated screwdriver, preset these controls to minimum (turn fully counterclockwise):
   - SCREEN (high-voltage block) (see Figure 70B)
   - C-LIM (video assembly) (see Figure 70C)
   - BRIGHT PRESET (video assembly) (see Figure 70C)
   - B, G, and R GAIN (video assembly) (see Figure 70C)
   - B, G, and R LEVEL (video assembly) (see Figure 70C)

Note For the next step, verify that the voltmeter is grounded to the monitor chassis and set to the 200 V DC setting.

Because the voltage at G1 (see Figure 70A) is a negative number, increasing the voltage can be confusing. If the initial voltage was -61 V, increasing the voltage by 4 volts would read -57 V.

10. Using the insulated screwdriver and a voltmeter, adjust the BRT PRESET control (see Figure 70C) until the voltage at G1 increases by 4 volts (± 0.2 V).
11. Adjust the SCREEN control (see Figure 70B) until the raster just appears. (The entire screen should be obviously tinted, but dark.)
12. Set the external brightness control to its center detent position.
13. Set the external contrast control to maximum contrast (turn fully clockwise).
14. Using the insulated screwdriver, turn the red, green, and blue GAIN controls (see Figure 70C) to midrange.
15. Using the insulated screwdriver, adjust the BRIGHT PRESET control (see Figure 70C) to minimum (turn fully counterclockwise).
16. Using Display Service Utility, display All-White Screen test pattern.

Note Note which meter you are using before making adjustments. Readings differ from light meter Model L-248 and Model 246. (See the section, "Light Meters" in Chapter 1, "General Monitor Information.")

17. Using the light meter and an insulated screwdriver, adjust the C-LIM control until the center of the all-white screen measures 27 foot lamberts (± 3 foot lamberts), which on the light meter is
    - Model L-248: low end of the 10 scale
    - Model 246: 21.5 on the red scale

Important If you cannot attain the correct reading, turn up (clockwise) 1/4 turn the three GAIN controls and repeat the C-LIM adjustment. If you doubt your meter's accuracy, verify the readings with a known-good light meter or photometer.

18. Using Display Service Utility, display the Gray Bars test patterns.
19. Using the insulated screwdriver, alternately adjust the red and blue LEVEL controls (see Figure 70C) until there is no colored tint in the right (darkest) five bars.

Note Use the green LEVEL control only if you cannot adjust the dark bars with the red and blue LEVEL controls.

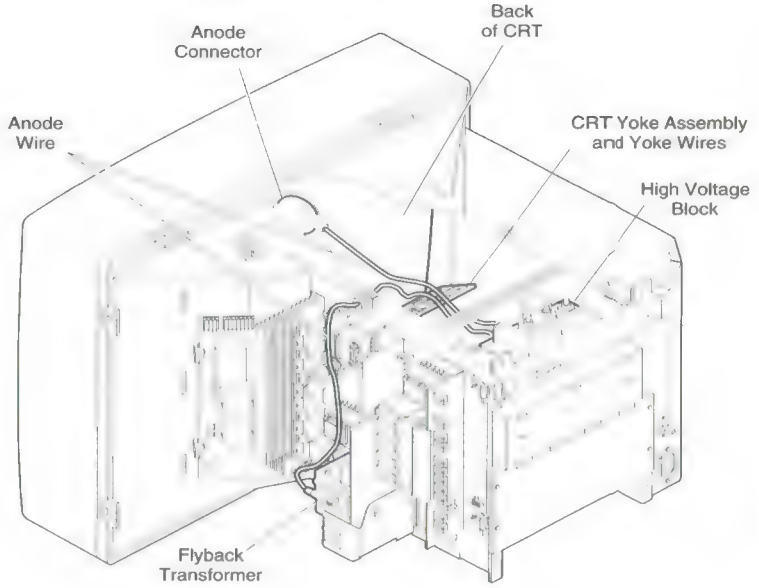
20. Using the insulated screwdriver, alternately adjust the three GAIN controls until there is no colored tint in the left (brightest) five bars.
21. Recheck the right (darkest) bars for a colored tint. If necessary, repeat the LEVEL and GAIN adjustments until there is no colored tint.
22. Adjust the SCREEN control (see Figure 70B) until the rightmost bar is as black as the border and the second bar is barely distinguishable from the black bar.
23. Recheck the gray bars for a colored tint. If necessary, repeat the LEVEL, GAIN, and SCREEN adjustments.
24. Using Display Service Utility, display All-White Screen test pattern.
25. Recheck screen luminance. If necessary, adjust the C-LIM control (see Figure 70C) until the center of the All-White Screen test pattern measures 27 foot lamberts (± 3 foot lamberts), which on the light meter is
    - Model L-248: low end of the 10 scale
    - Model 246: 21.5 on the red scale

Important If you cannot attain the correct reading, turn up (clockwise) 1/4 turn the three GAIN controls and repeat the C-LIM adjustment. If you doubt your meter's accuracy, verify the readings with a known-good light meter or photometer.

26. Recheck the gray bars for a colored tint. If necessary, repeat the LEVEL, GAIN, SCREEN, and C-LIM adjustments.

• WARNING •

Serious Injury could result if, with the power on, you touch any of the high-voltage area shown below. Review the CRT safety rules before preforming adjustments.



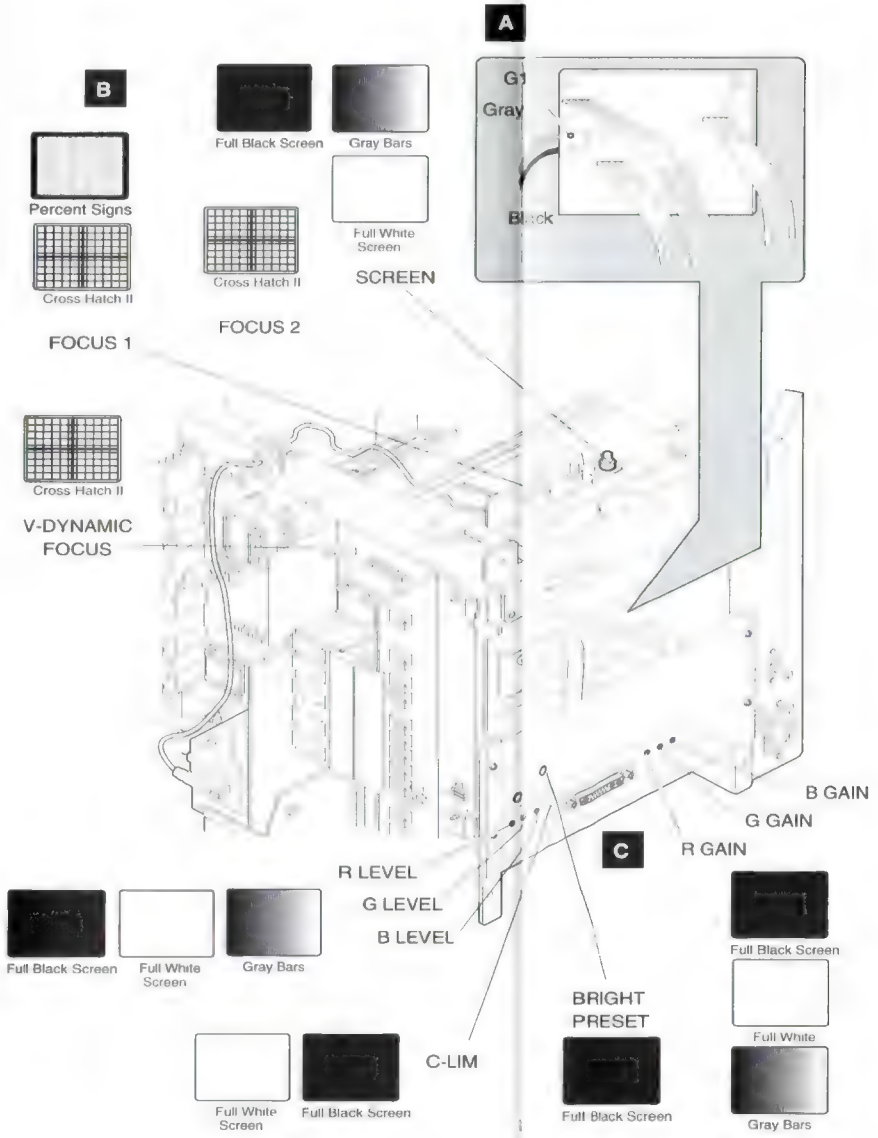
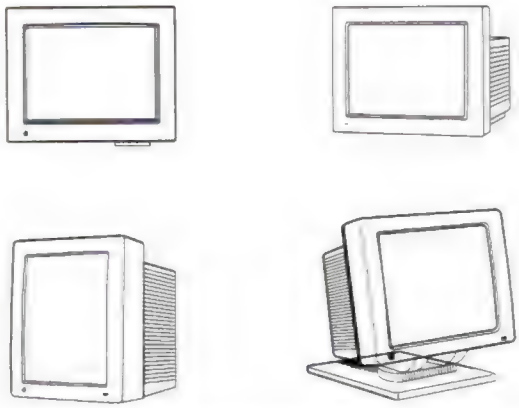


Figure 70. Macintosh 21" Color Display– Focus and Video Adjustments

Monochrome Displays



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Apple High-Resolution Monochrome Monitor

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Exploded View

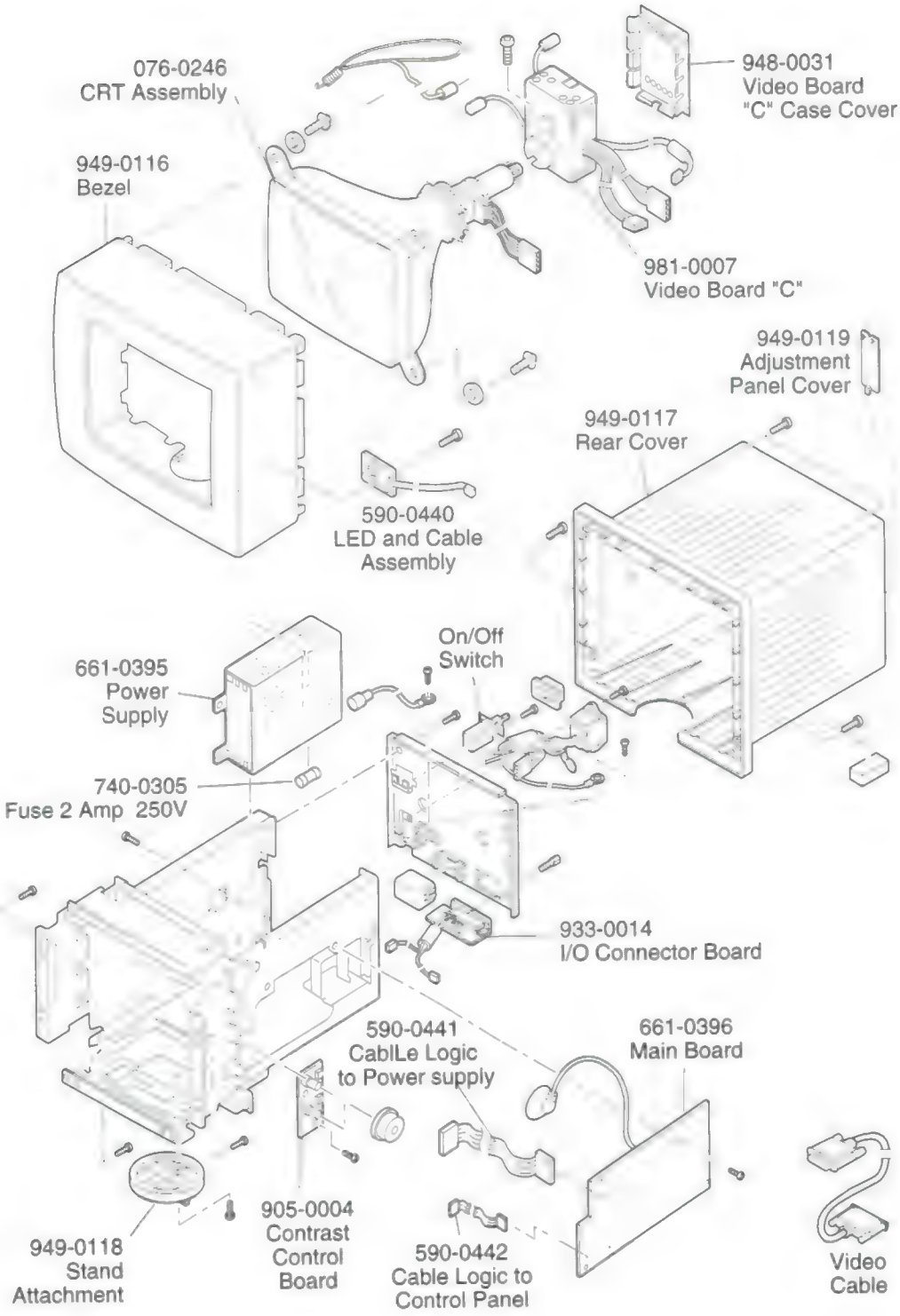
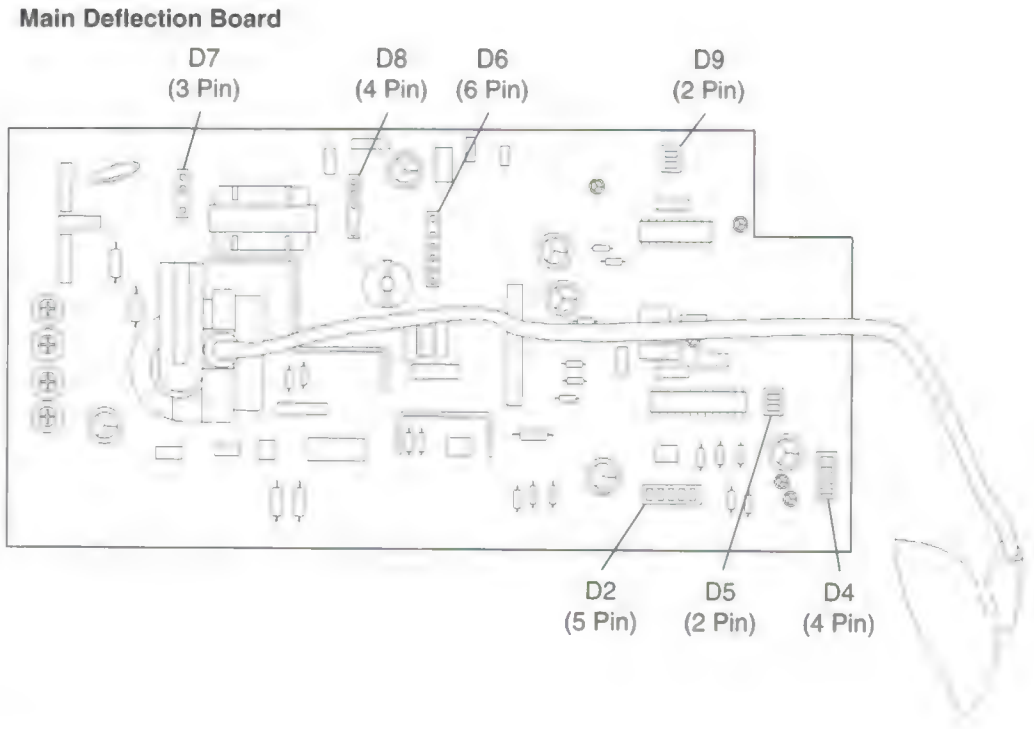


Figure 71. Apple High-Res Monochrome Monitor Exploded View



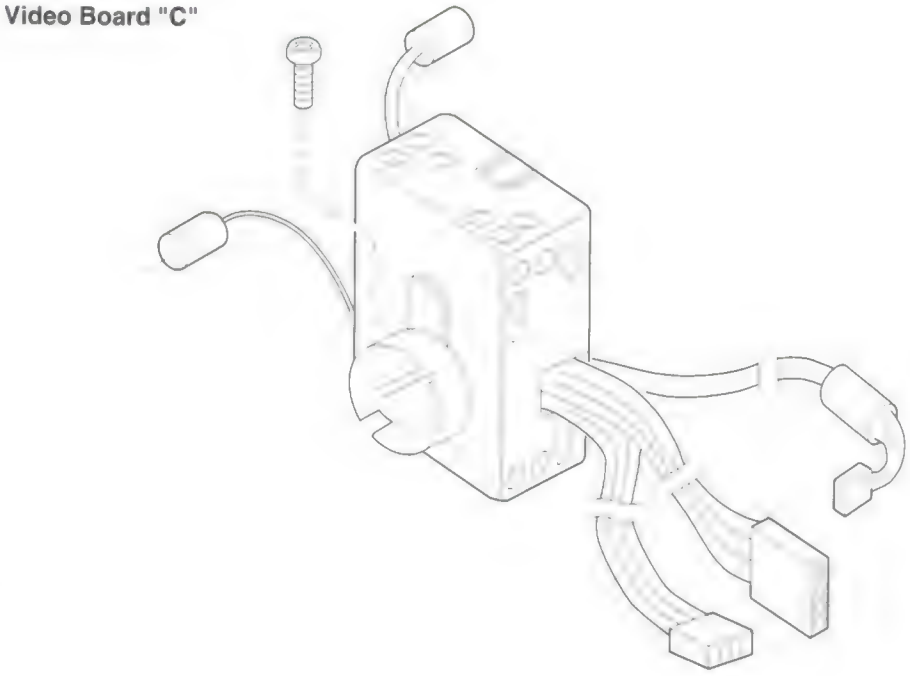


Figure 72. Main Circuit Boards

Parts List

Adjustment Panel Cover	949-0119
Apple High-Res Monochrome Adjustments Sub-Brightness, F	011-7087
Bezel, Plastic Case	949-0116
Cable, Assembly, LED	590-0440
Cable, CPU to Monitor, 1.75 Meter	590-4161
Cable, External Power, Domestic (120 V)	590-0372
Cable, External Power, European (220 V)	590-0422
Cable, Logic Bd. to Control Panel	590-0442
Cable, Logic Bd. to Power Supply	590-0441
Contrast Control Board	905-0004
CRT Assembly	076-0246
Facilitation Warranty Reimbursement, Per Repair	011-0083
Fuse, 250 V, 2 Amp	740-0305
I/O Connector Board	933-0014
Main Board	661-0396
Metal Cover, Video Board (C)	948-0031
Power Supply	661-0395
Rear Cover, Plastic	949-0117
Screw/Knob Set	956-0007
Stand Attachment, Plastic Bottom	949-0118
Video Board C w/Cable	981-0007

Symptom/Cure Chart

Use the following symptom/cure chart as a troubleshooting guide. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see Chapter 1, "General Monitor Information."

For additional assistance, contact Apple Technical Support.

No Raster	Solution
No raster, LED off	1. Ensure that monitor's video cable is connected to the computer or to the video card in the computer. 2. Verify that power cord is connected. 3. Check internal power connectors. 4. Replace fuse. 5. Replace power supply. 6. Replace power switch.
No raster, LED on	1. Ensure that monitor's video cable is connected to the computer or to the video card in the computer. 2. Adjust brightness and contrast knobs. 3. Replace video card (if present) in computer. 4. Adjust sub-brightness (Cutoff) control. 5. Check logic board connection to power supply. 6. Replace fuse. 7. Replace main board. 8. Replace power supply. 9. Replace power switch assembly. 10. Replace video board "C." 11. Replace contrast control board.

Geometry	Solution
Raster stretched or compressed on side or top of screen	1. Verify that distortion is not caused by environmental conditions. 2. Perform appropriate geometric adjustments. 3. Replace main board. 4. Replace CRT.

Synchronization	Solution
Picture breaks into diagonal lines	1. Connect another monitor to computer and verify presence of video signal. 2. Replace main board.
Picture rolls vertically	1. Verify that video card in computer is working properly. 2. Adjust vertical hold. 3. Check connector on I/O connector board. 4. Replace main board.
One horizontal or vertical line appears on screen	1. Check yoke connectors. 2. Replace main board. 3. Replace CRT.

Video	Solution
Picture too dark or too bright	1. Adjust brightness knob. 2. Verify that video card in computer is working properly. 3. Adjust sub-brightness (Cutoff) control. 4. Replace main board. 5. Replace video board "C." 6. Replace CRT.
Brightness unadjustable	1. Replace contrast control board. 2. Replace main board. 3. Replace video board "C." 4. Replace CRT.
Out of focus	1. Perform focus adjustments. 2. Replace main board. 3. Replace video board "C." 4. Replace CRT.

Miscellaneous	Solution
Picture jitters	1. Check grounding cable connections to chassis. 2. Confirm that adjacent computer equipment is properly grounded. Move electrical devices away from monitor. Temporarily shut off fluorescent lights in area. 3. Replace main board.

Flashing lines on screen	1. Confirm contact of video connector to neck of CRT. 2. Replace contrast control board. 3. Replace main board.
Black spots on screen (burnt phosphors)	Replace CRT.

Adjustments

Geometry

▲ Warning **This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review the CRT safety rules in Chapter 1, "General Monitor Information."**

Note Reference the "Video Adjustments Foldout," Figure 73, when performing all Geometry and Video adjustments. Unfold Figure 73 so the graphic is visible while making adjustments.

▲ Warning **Because adjustments are made from the rear of the computer, position a mirror to view the computer screen. Do not reach around the computer to adjust the controls.**

Do not attempt yoke adjustments on this monitor. The geometry adjustment controls are behind the service access panel. Geometry adjustments may be necessary whenever you replace the main deflection board, CRT, or video board.

Horizontal Size

Note Always adjust the horizontal size before you adjust the vertical size. The horizontal adjustment can affect the height of the raster.

1. Set the contrast knob to maximum and the brightness knob to the center (detent) position (see Figure 73A).
2. Use Display Service Utility to display the Crosshatch II (white background) test pattern.
3. Using a plastic screwdriver, adjust the horizontal size control (see Figure 73A) until the raster is 8.4 inches (213.5 mm) wide.

Vertical Size

Note Always adjust the horizontal size before you adjust the vertical size. The horizontal adjustment can affect the height of the raster.

Using the Crosshatch II test pattern and a plastic screwdriver, adjust the vertical size control (see Figure 73A) until the raster is 6.3 inches (160 mm) high.

Focus

1. Use Display Service Utility to display the Focus test pattern.
2. Using a plastic screwdriver, adjust the focus control (see Figure 73A) for the best clarity at the center of the screen.

Video

Note After you replace the contrast control board, main deflection board, or video board, you may need to perform video adjustments.

Before you begin:

- Remove the rear cover
- Connect the video cable
- Connect the power cord

Cutoff

1. Using a plastic screwdriver two inches in length, adjust the subcontrast control (see Figure 73B) until the control is midway between the high and low stops.
2. Verify that the Control Panel is set to 16 Grays.
3. Use Display Service Utility to display the Gray Bars test pattern.
4. Set the contrast knob to maximum and the brightness knob to the center (detent) position (see Figure 73A).
5. Using the plastic screwdriver, adjust the Cutoff control (RV506) until the first bar from the left is black and the second bar is just visible (see Figure 73A).

Note If you adjust the Cutoff control up (clockwise) too far, the monitor may shut down. If this happens, switch off the monitor and turn the Cutoff control all the way down (counterclockwise). Wait 30 seconds, switch on the monitor, and resume the adjustment.

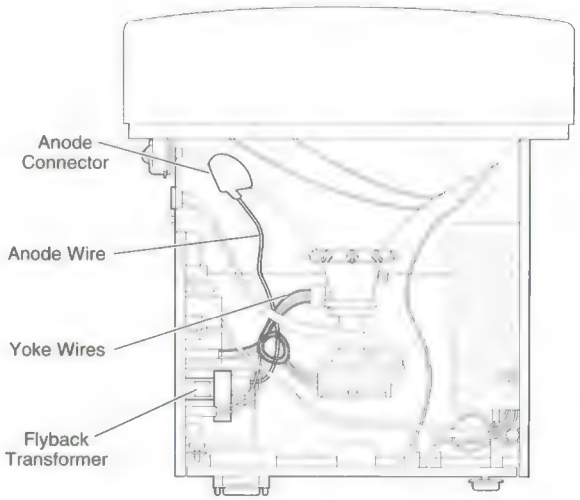
Subcontrast

Important Readings from light meter Model L-248 and Model 246 differ. Please note which meter you are using before making adjustments. (See the section, "Light Meter Setup," in Chapter 1.)

1. Using Display Service Utility, display the All-White Screen test pattern.
2. Using the light meter and a plastic screwdriver, adjust the Cutoff control (see Figure 73A) until you get 33 foot lamberts (± 3 foot lamberts), which on the light meter is
   - Model L-248: middle of the 10 scale
   - Model 246: 25 on the red scale

Safety • WARNING •

Serious Injury could result if, with the power on, you touch any of the high-voltage area shown below. Review the CRT safety rules before performing adjustments.



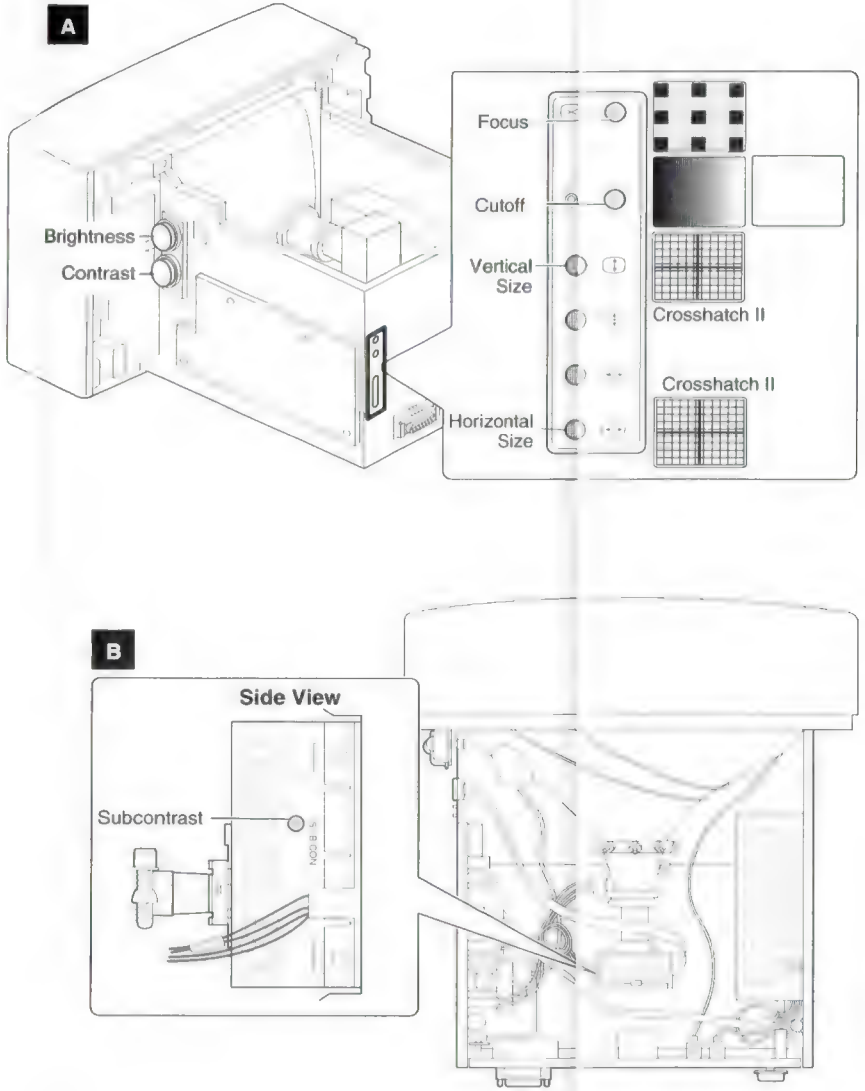


Figure 73. Apple Color High-Resolution RGB Adjustments

Macintosh 12" Monochrome Display

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Exploded View

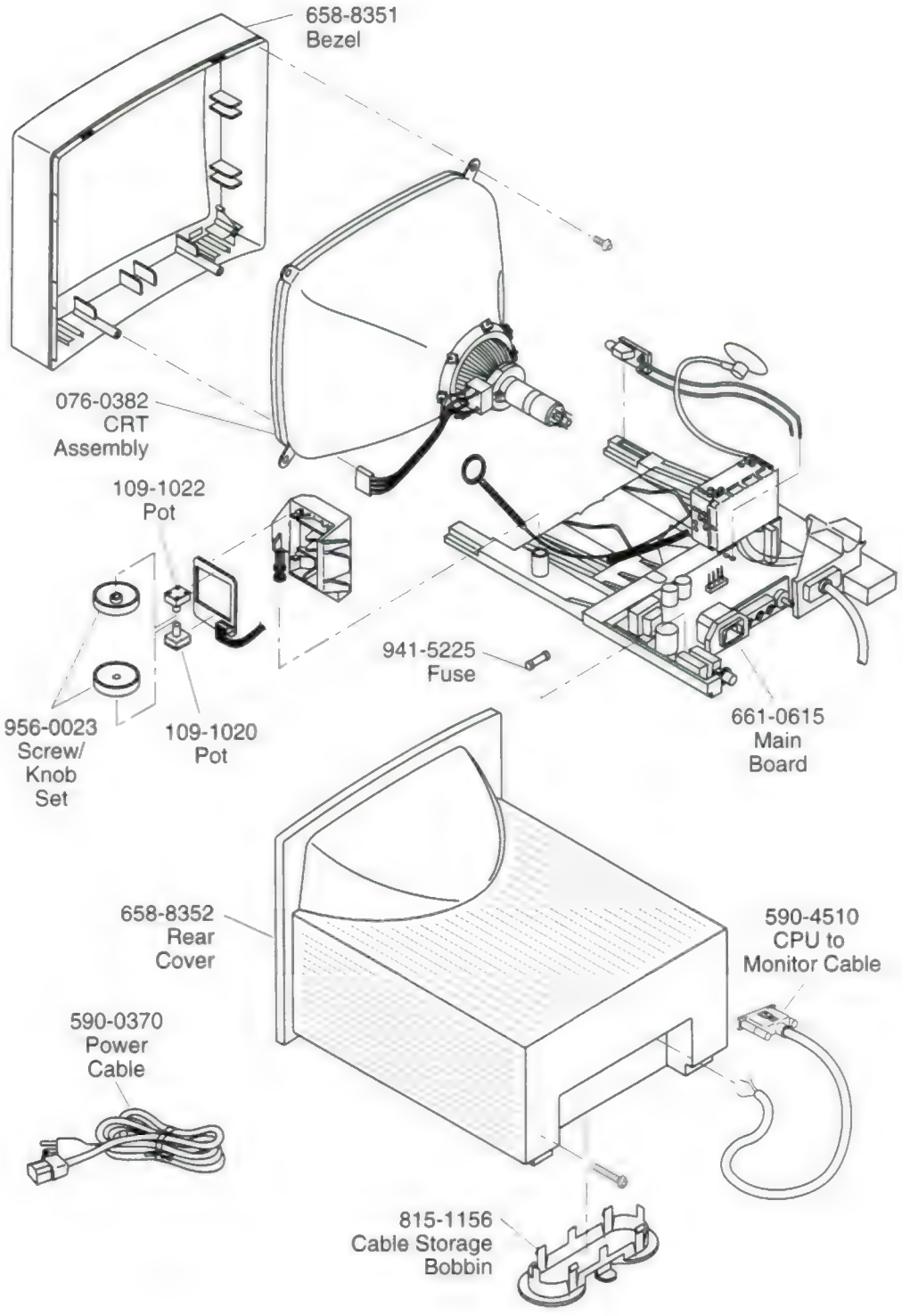


Figure 74. Macintosh 12" Monochrome Display Exploded View

Main Circuit Board

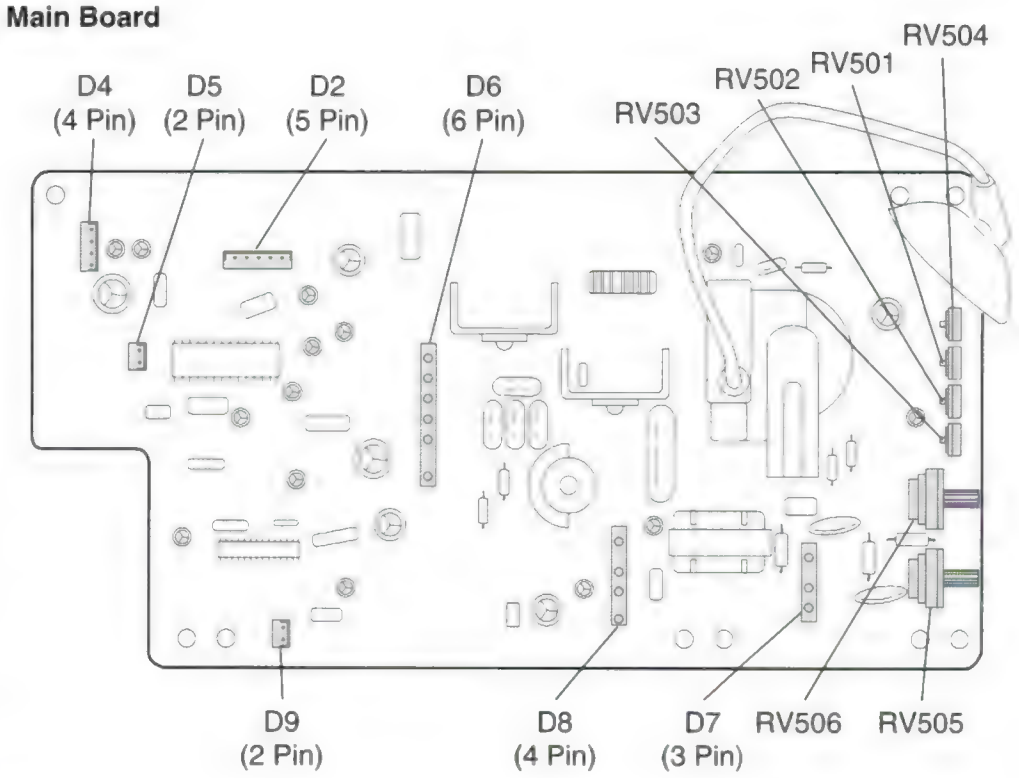


Figure 75. Macintosh 12" Monochrome Main Board

Parts List

Bezel, Plastic Case	658-8351
Cable Storage Bobbin	815-1156
Cable, CPU to Monitor	590-4510
Cable, External Power Hi-Res (1M)	590-0370
CRT Assembly, Domestic & Europe	076-0382
Facilitation Warranty Reimbursement, Per Repair	011-0083
Fuse, 2.5A, 250 V, Slo Blo (Pkg. of 5)	941-5225
Macintosh 12" Monochrome Display	011-0424
Main Board	661-0615
Pot, 10K Ω 0.15W CC Brightness	109-1022
Pot, 10K Ω 0.15W Contrast	109-1020
Rear Cover, Plastic	658-8352
Screw/Knob Set	956-0023

Troubleshooting

Symptom/Cure Chart

Use the following symptom/cure chart as a troubleshooting guide. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement.

For additional assistance, contact Apple Technical Support.

No Raster	Solutions
No raster, LED off	1. Ensure that monitor's video cable is connected to computer or to video card in the computer. 2. Verify that power cord is connected. 3. Check internal power connections. 4. Replace blown fuse. 5. Replace main board.
No raster, LED on	1. Ensure that monitor's video cable is connected to computer or to video card in the computer. 2. Adjust brightness and contrast knobs. 3. Adjust sub-brightness control. 4. Replace main board. 5. Replace contrast/brightness assembly. 6. Replace CRT.

Geometry	Solutions
Cannot center raster	1. Verify that distortion is not caused by environmental conditions. Move monitor to different location. 2. Replace main board.
Raster stretched or compressed on side or top of screen	1. Verify that distortion is not caused by environmental conditions. Move monitor to different location. 2. Replace main board. 3. Replace CRT.

Synchronization	Solutions
Picture breaks into diagonal lines	1. Connect another monitor and verify that video signal is coming from computer. 2. Replace main board.

Picture rolls vertically	1. Verify that video card in computer is working properly. 2. Replace main board.
One horizontal or vertical line appears on screen	1. Check yoke connectors. 2. Replace main board. 3. Replace CRT.

Video	**Solutions**
Flashing lines appear on screen	1. Verify connection of video board to neck of CRT. 2. Replace contrast/brightness assembly. 3. Replace main board.
Picture is too dark or too bright	1. Adjust brightness knob. 2. Verify that video card in computer is working properly. 3. Adjust sub-brightness control. 4. Replace main board. 5. Replace CRT.
Cannot adjust brightness	1. Replace contrast/brightness assembly. 2. Replace main board. 3. Replace CRT.
Out of focus	1. Perform focus adjustments. 2. Replace main board. 3. Replace CRT.

Miscellaneous	**Solutions**
Picture jitters	1. Verify that grounding cables are attached to chassis. 2. Verify that adjacent computer equipment is properly grounded. Move electrical devices away from monitor. Temporarily shut off all fluorescent lights in area. 3. Replace main board.
Black spots on screen (burnt phosphors)	Replace CRT.

Adjustments

Geometry

▲ Warning **This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review the CRT safety rules in Chapter 1, "General Monitor Information."**

Note Reference the "Video Adjustments Foldout," Figure 76, when performing all Geometry and Video adjustments. Unfold Figure 76 so the graphic is visible while making adjustments.

Do not attempt yoke adjustments on this display. The manufacturer performs all such adjustments.

Perform geometry adjustments whenever you replace the main board.

Horizontal Size

1. Use Display Service Utility to display the All-White Screen or Cross-hatch II test pattern.
2. Using a plastic screwdriver, adjust the Horizontal Size control (see Figure 76) until the raster is 8 7/16 in. (± 1/8 in.) or 213.5 mm (± 2 mm) wide.

Horizontal Center

Using a plastic screwdriver, adjust the Horizontal Centering control (see Figure 76) until the raster is positioned in the approximate center of the screen.

Vertical Size

Using the plastic screwdriver, adjust the Vertical Size control (see Figure 76) until the raster is 6 5/16 in. (± 1/8 in.) or 159.5 mm (± 2 mm) high.

Vertical Center

1. Using the plastic screwdriver, adjust the Vertical Centering control (see Figure 76) until the raster is positioned in the approximate center of the screen.
2. Verify that the raster height is 6 5/16 in. (± 1/8 in.) or 159.5 mm (± 2 mm) high. If not, repeat the vertical size and vertical center adjustments.

Note Vertical height and horizontal size affect each other. Recheck the horizontal and vertical specifications and, if necessary, repeat the adjustments.

Focus

1. Use Display Service Utility to display the Focus test pattern.
2. Set the contrast knob to maximum and the brightness knob to the center (detent) position (see Figure 76).
3. Using a plastic screwdriver, adjust the focus control until the Focus test pattern is as clear as possible.

Video

▲ Warning **Because adjustments are made from the rear of the computer, position a mirror to view the computer screen. Do not reach around the computer to adjust the controls.**

Note Perform video adjustments whenever you replace the CRT or video board. You may need to perform video adjustments when you replace other modules.

1. Set the Control Panel to display 16 grays on the monitor.
2. Set the external (user) contrast knob to maximum and the external brightness knob to the center (detent) position (see Figure 76).
3. Use Display Service Utility to display the Gray Bars Screen test pattern.
4. Adjust the sub-brightness control (see Figure 76) until the left bar is black and the next bar is barely distinguishable from the black bar.

Note If you adjust the sub-brightness control too high, the edges of the bars will appear dashed or irregular. To correct this problem, adjust the sub-brightness control down about a quarter-turn and then perform the sub-brightness adjustment.

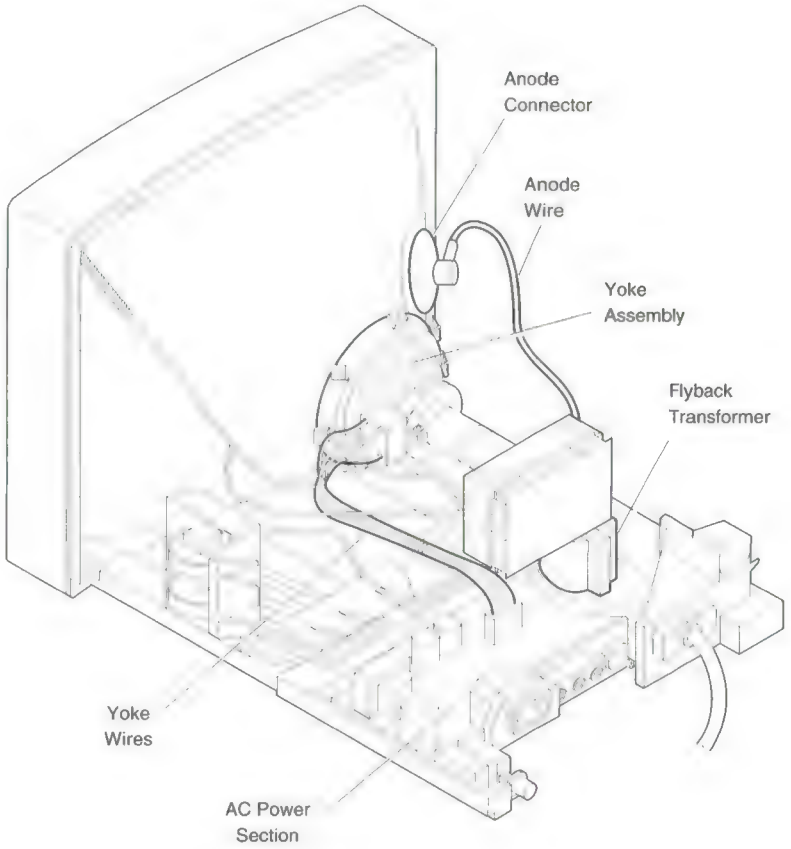
5. Use Display Service Utility to display the All-White Screen test pattern.

Note Note which meter you are using before making adjustments. Readings differ from light meter Model L-248 and Model 246. (See the section, "Light Meters" in Chapter 1, "General Monitor Information.")

6. Using the light meter and a plastic screwdriver, adjust the sub-contrast control (see Figure 76) until you get 33 foot lamberts (± 3 foot lamberts), which on the light meter is
   - Model L-248: middle of the 10 scale
   - Model 246: 25 on the red scale

• WARNING •

Serious Injury could result if, with the power on, you touch any of the high-voltage area shown below. Review the CRT safety rules before preforming adjustments.



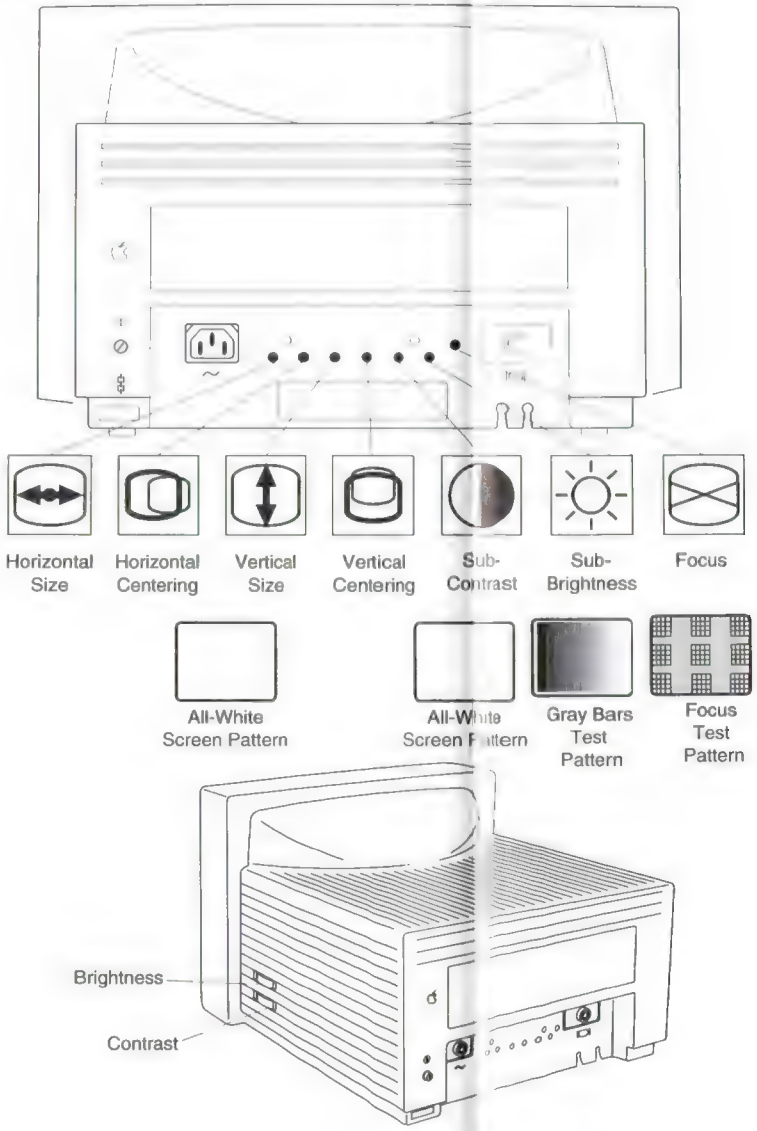


Figure 76. Macintosh 12" Monochrome Display Adjustments

Macintosh Portrait Display

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Exploded View

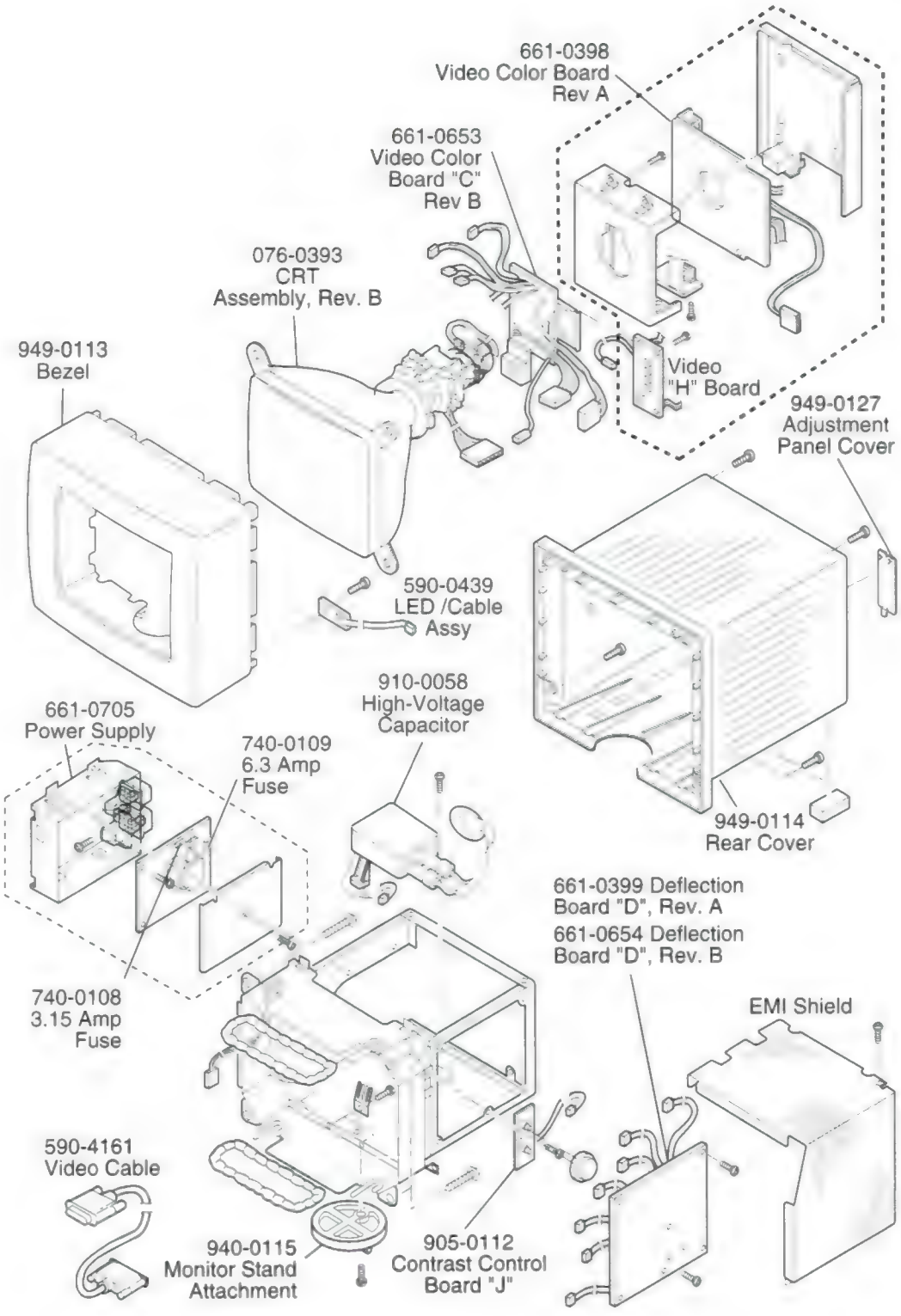


Figure 77. Macintosh Portrait Display Exploded View

Main Circuit Boards

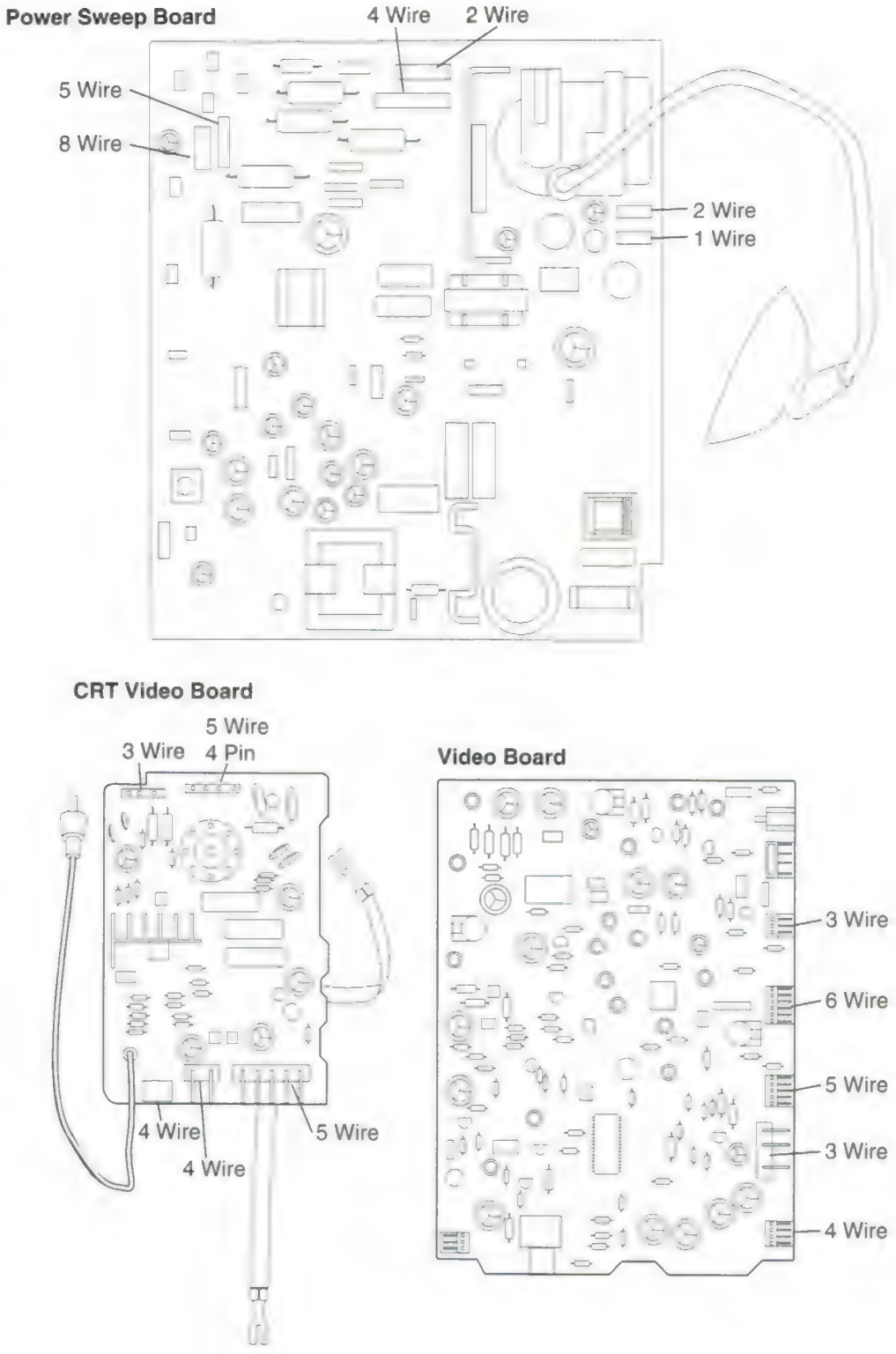


Figure 78. Macintosh Portrait Display Main Circuit Boards

Parts List

AC Input Assembly with fuse	937-0019
Adjustment Magnet Kit	949-0253
Apple Portrait Display Adjustment	011-0071
Bezel, Plastic Case	949-0079
Cable Assembly, LED	590-0071
Cable, ADB, CPU/Tilt-Swivel Monitor Stand	590-4501
Cable, Power, 1.9M, European	590-0421
Cable, Power, 1.9M, U.S.	590-0371
Cable, Video, DB15 to DB25	590-0615
Cable, Video, DB25 to DB25	590-0574
Contrast Brightness Board	982-0004
CRT Assembly	076-0350
CRT Video Board	661-0119
Facilitation Warranty Reimbursement, Per Repair	011-0083
Fan	983-0014
Fuse, 4 amp, 250 V (Pkg. of 5)	941-0017
Magnet Adjustment	011-7602
Power/Sweep Board	661-0117
Rear Cover, Plastic	949-0089
Screw/Knob Set	956-0015
Signal Input Assembly	937-0022
Video Board	661-0118

International "Series B"

Apple produced domestic and international versions of the Portrait Display. The troubleshooting and repair procedures differ for each version of the monitor. This chapter covers the domestic version only.

The documentation on the Portrait Display "Series B," is contained on the *Service Source CD*.

Monitor Distortion

All large-screen monitors are susceptible to distortions caused by environmental conditions. These distortions are usually not visible on monitors with smaller screens.

Important Even monitors set to factory specifications may appear distorted when set up in a new environment.

Always check first for environmental causes before attempting to repair or adjust a monitor with a distorted raster.

Environmental Influences

The following environmental conditions may distort the raster of a Portrait Display:

- Proximity to metal objects (such as metal desks, file cabinets, and bookshelves). Metal objects affect the earth's magnetic field. Earth magnetism usually distorts only the edges of the screen.
- Fluorescent lights, other monitors, or electronic appliances (such as coffee makers and copy machines). These objects cause dynamic raster distortion (that is, movement or jitter of the image).

Important Module swapping cannot fix a monitor with environmental distortion problems, and adjusting a monitor with such problems alters the factory settings.

If the monitor has shifted up/down or right/left only, adjust it using the centering controls. However, keep in mind that if you then move the monitor, you may need to readjust the centering controls.

Before adjusting a monitor with a distorted raster, try the following:

- Swivel or move the monitor
- Remove the monitor from the building and recheck it in another location.

If the display changes (for better or worse) when you move it to another location, the environment is the source of the problem. Relocate the monitor or remove the distortion-causing object.

If the display does not change when you move it to another location, continue troubleshooting the problem (refer to Symptom/Cure Chart).

Symptom/Cure Chart

The Symptom/Cure Chart included in this chapter will help you diagnose specific symptoms related to your product. Because cures are listed on the chart in the order of most likely solution, try the first cure first. Verify whether the product continues to exhibit the symptom. If the symptom persists, try the next cure. (Note: If you have replaced a module, reinstall the original module before you proceed to the next cure.)

For additional assistance, contact Apple Technical Support.

No Raster	**Solutions**
No raster, LED off	1. Ensure that monitor's video cable is connected to computer or to video card in the computer. 2. Check power cable connections. 3. Check internal power connections. 4. Replace blown fuse. 5. Replace power/sweep board. 6. Replace video board.
No raster, LED on	1. Ensure that monitor's video cable is connected to computer or to video card in the computer. 2. Adjust brightness and contrast knobs. 3. Verify that video card in computer is working properly. 4. Perform video adjustments. 5. Check internal power connections. 6. Replace power/sweep board. 7. Replace CRT board. 8. Replace video board. 9. Replace CRT.

Geometry	**Solutions**
Raster not centered	1. Verify that distortion is not caused by environmental conditions. Move monitor to another location. 2. Perform horizontal or vertical center adjustments. 3. Replace power/sweep board. 4. Replace CRT.
Raster bulges along top of screen	1. Verify that distortion is not caused by environmental conditions. Move monitor to another location. 2. Replace CRT.

Raster stretched or compressed at top	1. Verify that distortion is not caused by environmental conditions. Move monitor to another location. 2. Perform vertical-linearity adjustment. 3. Replace power/sweep board. 4. Replace CRT.
Raster short (less than 10 7/8 inches high)	1. Perform vertical-height adjustment. 2. Replace power/sweep board. 3. Replace CRT.
Raster narrow (less than 8 inches wide)	1. Perform horizontal-size adjustment. 2. Replace power/sweep board. 3. Replace CRT.
Raster bowed or barrel-shaped	1. Verify that distortion is not caused by environmental conditions. Move monitor to another location. 2. Perform video adjustment. 3. Replace power/sweep board. 4. Replace CRT.
Raster pyramid shaped (or inverted pyramid)	Replace CRT.

Video Display	**Solutions**
Picture is too dark or too bright	1. Adjust contrast and brightness knobs. 2. Verify that video card in computer is working properly. 3. Perform video adjustments. 4. Replace CRT board. 5. Replace video board. 6. Replace contrast/brightness board. 7. Replace CRT.
Out of focus	1. Perform focus adjustments. 2. Replace power/sweep board. 3. Replace CRT.

Synchronization	Solutions
Picture rolls vertically	1. Verify that video card in computer is working properly. 2. Replace power/sweep board.
One thin, bright, horizontal line appears on screen	1. Replace power/sweep board. 2. Replace CRT.
Picture breaks into diagonal lines	1. Connect another monitor to computer and verify video signal. 2. Replace power/sweep board.

Miscellaneous	Solutions
Black spots on screen (burnt phosphors)	Replace CRT.
Picture jitters or flashes	1. Check all ground cable connections. 2. Verify that adjacent computer equipment is properly grounded. Move electrical devices away from monitor and shut off fluorescent lights in area. 3. Replace power/sweep board.
Intermittently shuts down	1. Ensure that monitor's video cable is connected to computer or to video card in the computer. 2. Replace power/sweep board

Geometry

Before you begin, remove the rear cover.

▲ Warning **This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review the CRT safety rules in Chapter 1, "General Monitor Information."**

▲ Warning **Because adjustments are made from the rear of the computer, position a mirror to view the computer screen. Do not reach around the computer to adjust the controls.**

▲ Caution **When measuring voltage, avoid a possible short. Switch off the monitor before connecting and disconnecting the alligator clips to/from the test points.**

Geometry adjustments may be necessary whenever you replace the power/sweep board.

Note Reference the "Video Adjustments Foldout," Figure 79, when performing all Geometry and Video adjustments. Unfold Figure 79 so the graphic is visible while making adjustments.

Horizontal Size

1. Use Display Service Utility to display the All-White Screen test pattern.
2. Using the plastic screwdriver, adjust the horizontal size (H.SIZE) control (see Figure 79A) until the raster width is 8 in. (± 1/8 in.) or 203 mm (± 2 mm).

Horizontal Center

1. Using the plastic screwdriver, adjust the horizontal center (H.CENT) control (see Figure 79A) until the raster is centered (left to right) in the display area.
2. Verify that the raster width is 8 in. (± 1/8 in.) or 203 mm (± 2 mm) wide. If it is not, repeat the horizontal size and horizontal center adjustments.

Horizontal Phase

1. Measure the black margin on the right side of the display. The black margin should measure 1/4 in. (or 7 to 8 mm) from the right edge of the white raster to the edge of the plastic bezel.
2. If necessary, use the plastic screwdriver to adjust the horizontal phase (H.PHASE) control (see Figure 79A) until the black margin is 1/4 in. (or 7 to 8 mm) wide.

Height

Using a plastic screwdriver, adjust the height control until the raster height is 10 7/8 in. (± 1/8 in.) or 276 mm (± 2 mm).

Vertical Center

1. Using the plastic screwdriver, adjust the vertical center (V.CENT) control until the raster is centered (top to bottom) in the display area.
2. Verify that the raster height is 10 7/8 in. (± 1/8 in.) or 276 mm (± 2 mm). If it is not, repeat the height and vertical center adjustments.

Vertical Linearity

1. Use Display Service Utility to display the Crosshatch test pattern.
2. Using a plastic screwdriver, adjust the vertical linearity (V.LIN) control (see Figure 79A) until the boxes at the top of the display are the same size as those at the bottom.

Focus

1. Use Display Service Utility to display the Focus test pattern.
2. Set the external contrast control to maximum (turn fully clockwise) and the external brightness control to the center (detent) position.
3. Using a plastic screwdriver, adjust the focus controls (see Figure 79A) as follows:
   - Adjust the focus control for the best overall focus
   - Adjust the H.FOCUS control for the best focus along the left and right edges of the display
   - Adjust the V.FOCUS control for the best focus at the top and bottom
4. Repeat the adjustments until you have attained the best focus possible.

Video With Screen Control

Before you begin, remove the following:

- Rear cover
- EMI shield

If the monitor doesn't have a screen control, go to the section, "Video Without Screen Control."

▲ Caution **To prevent damaging the monitor, reinstall the signal input board with the two mounting screws.**

Perform the video adjustments whenever the CRT or video board has been replaced or the display appears to be maladjusted.

1. Switch on the monitor and let it warm up for at least 10 minutes.
2. Use Display Service Utility to display the Gray Bars test pattern.
3. Using a plastic screwdriver, preset the following controls:
   - SCREEN control (see Figure 79A) to maximum (turn fully clockwise)
   - GAIN control (see Figure 79B) to its midpoint
   - SUB.BRIGHT control (see Figure 79B) to maximum (turn fully clockwise)

Cutoff

1. Use Display Service Utility to display the All-Black Screen test pattern.
2. Set the contrast control and the brightness control (see Figure 79B) to maximum (turn fully clockwise).

Note

3. If you turn the Cutoff control (see Figure 79B) up (clockwise) too far, the monitor may shut down. If this happens, switch off the monitor, turn the Cutoff control all the way down, and wait 30 seconds. Then resume the adjustment.

   Using the plastic screwdriver, adjust the Cutoff control clockwise until retrace lines are just visible.
4. Then turn the Cutoff control counterclock-wise until the retrace lines just disappear.

Sub-Brightness

1. Use Display Service Utility to display the Gray Bars test pattern.
2. Set the brightness control to the center (detent) position.
3. Set the SUB.BRIGHT control (see Figure 79B) so that the leftmost bar is completely black.

Screen Luminance

1. Use Display Service Utility to display the All-White Screen test pattern.

Note Note which meter you are using before making adjustments. Readings differ from light meter Model L-248 and Model 246. (See the section, "Light Meters" in Chapter 1, "General Monitor Information.")

2. Measure screen luminance. You should get 40 foot lamberts (± 3 foot lamberts), which on the light meter is
   - Model L-248: 10 to 11 on the 10–18 scale
   - Model 246: 29 on the red scale
3. Set the brightness control to the center (detent) position, and recheck the screen luminance. The luminance reading should not go beyond 60 foot lamberts, which on the light meter is
   - Model L-248: 11 to 12 on the 10–18 scale
   - Model 246: 40 on the red scale
4. If necessary, repeat the SUB.BRIGHT and GAIN adjustments until you obtain a correct reading.

Video Without Screen Control

Before you begin, remove the following:

- Rear cover
- EMI shield

▲ Caution **To prevent damaging the monitor, reinstall the signal input board with the two mounting screws.**

Note Perform the video adjustments whenever the CRT or video board has been replaced or the display appears to be maladjusted.

Bias

1. Switch on the monitor and let it warm up for at least 10 minutes.
2. Preset the SUB.BRIGHT control (see Figure 79B) to minimum (fully counterclockwise).
3. Use Display Service Utility to display the All-Black Screen test pattern.
4. Set the brightness control and contrast control to minimum (turn fully counterclockwise).

Note

5. For accurate voltage measurements, use two shielded alligator clip leads and a high quality DC voltmeter.
6. Connect one end of a shielded alligator clip lead to TP1 (see Figure 79C) on the CRT board. Connect the other end to the positive probe of a DC voltmeter.
7. Connect one end of a second shielded alligator clip lead to TP2 (see Figure 79C) on the CRT board. Connect the other end to the negative probe of the DC voltmeter.
8. Switch on the monitor.
9. Adjust the BIAS control (see Figure 79B) with a plastic screwdriver until the voltmeter measures 55 V DC ± 1.0 V.
10. Switch off the monitor.
11. Disconnect the alligator clips from TP1 and TP2.
12. Switch on the monitor.
13. Set the brightness control and contrast control to maximum (turn fully clockwise).

Cutoff

1. Set the SUB.BRIGHT control (see Figure 79B) to the midpoint.
2. Use Display Service Utility to display the Gray Bars test pattern (16 shades of gray).

Note

3. If you turn the Cutoff control (see Figure 79 B) up (clockwise) too far, the monitor may shut down. If this happens, switch off the monitor, turn the cutoff control all the way down, and wait 30 seconds. Then resume the adjustment.
4. Using the plastic screwdriver, adjust the Cutoff control until the leftmost gray bar turns completely black.
5. Set the brightness control to the center (detent) position.

Screen Luminance

1. Using Display Service Utility, display the All-White Screen test pattern.

Note Note which meter you are using before making adjustments. Readings differ from light meter Model L-248 and Model 246. (See the section, "Light Meters" in Chapter 1, "General Monitor Information.")

2. Using the light meter and a plastic screwdriver, adjust the GAIN control (see Figure 79B) until you get 40 foot lamberts (± 3 foot lamberts), which on the light meter is
   - Model L-248: 10 to 11 on the 10–18 scale
   - Model 246: 29 on the red scale

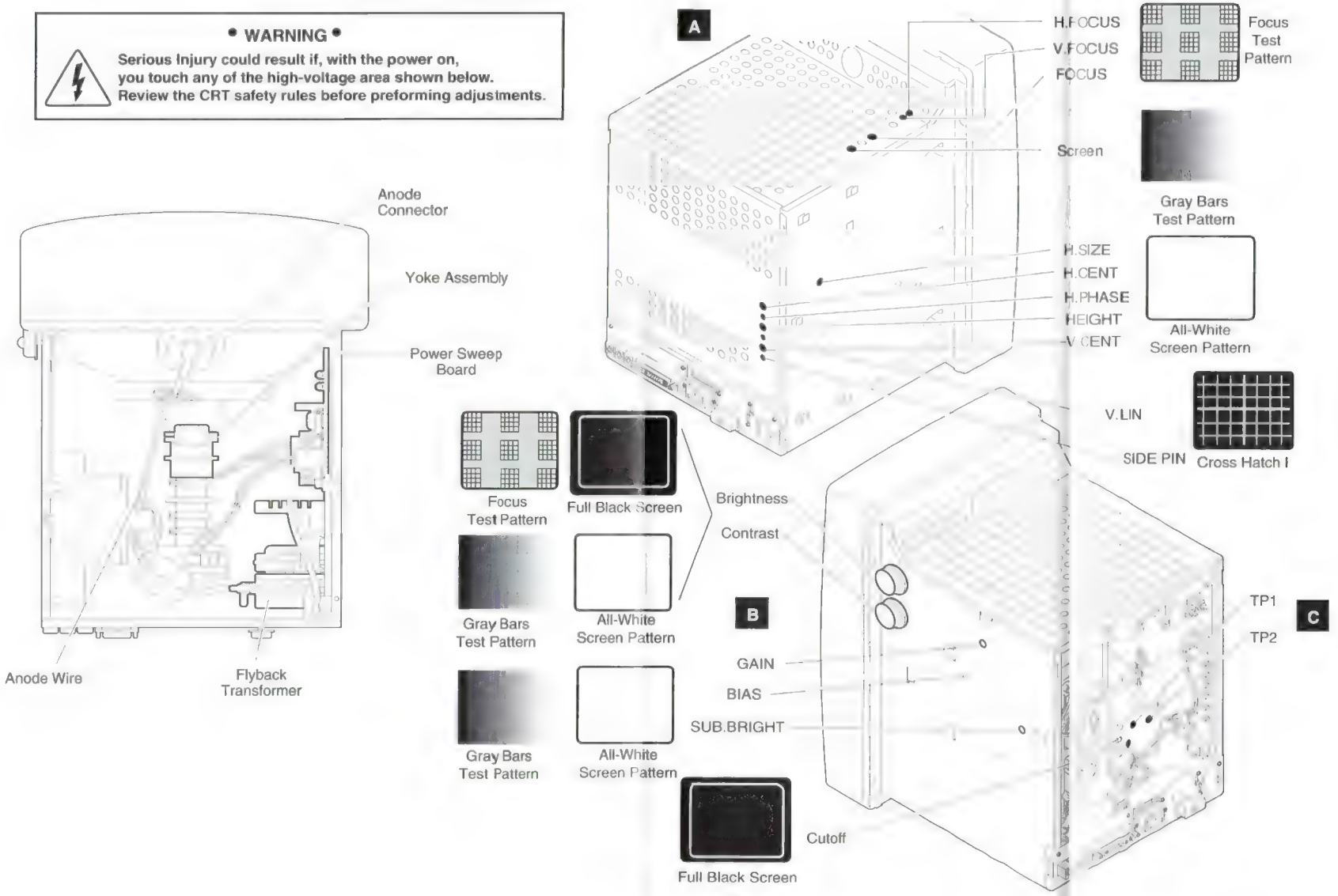
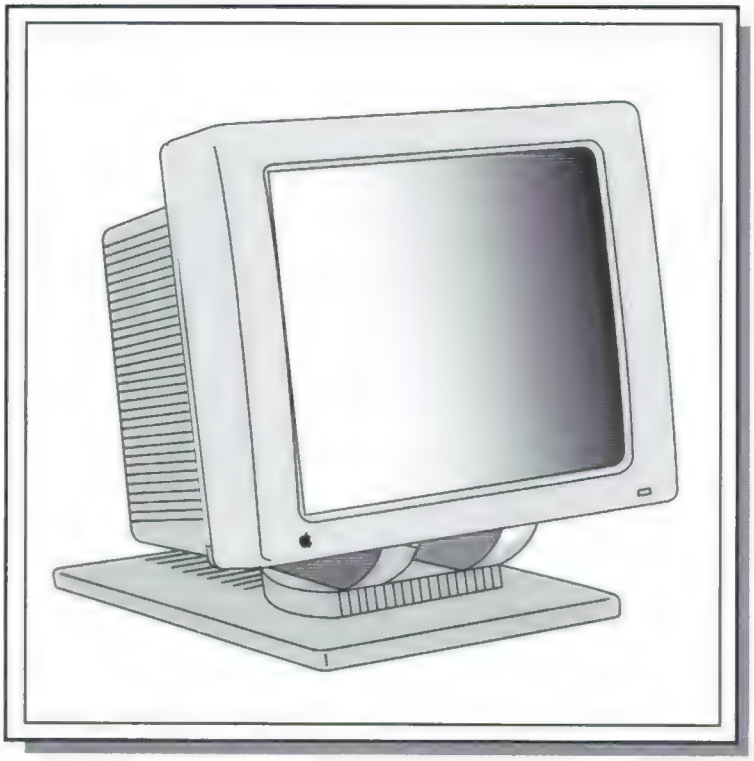


Figure 79. Macintosh Portrait Display– Adjustments

Apple Two-Page Monochrome Monitor



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Exploded View

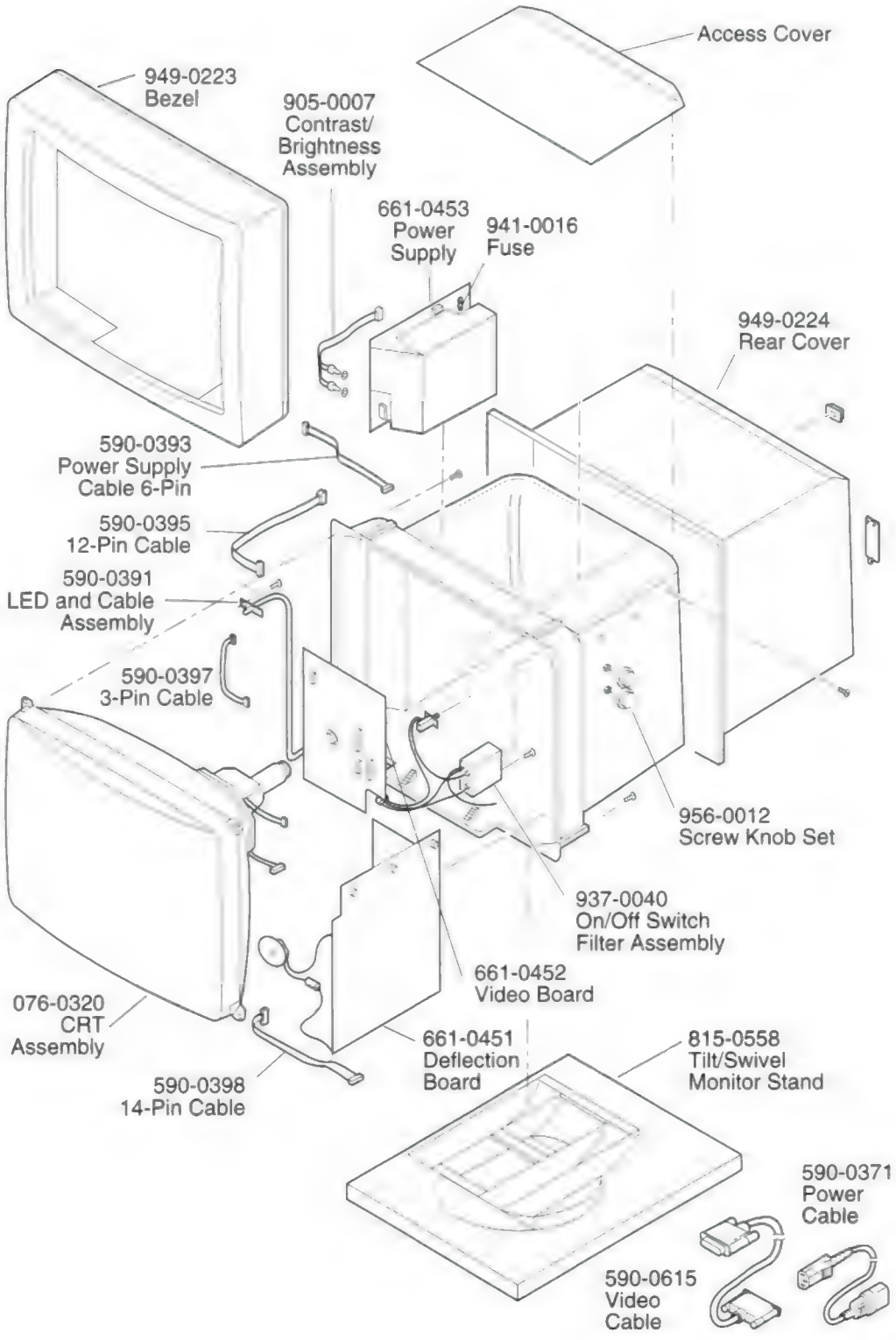


Figure 80. Apple Two-Page Monochrome Monitor Exploded View

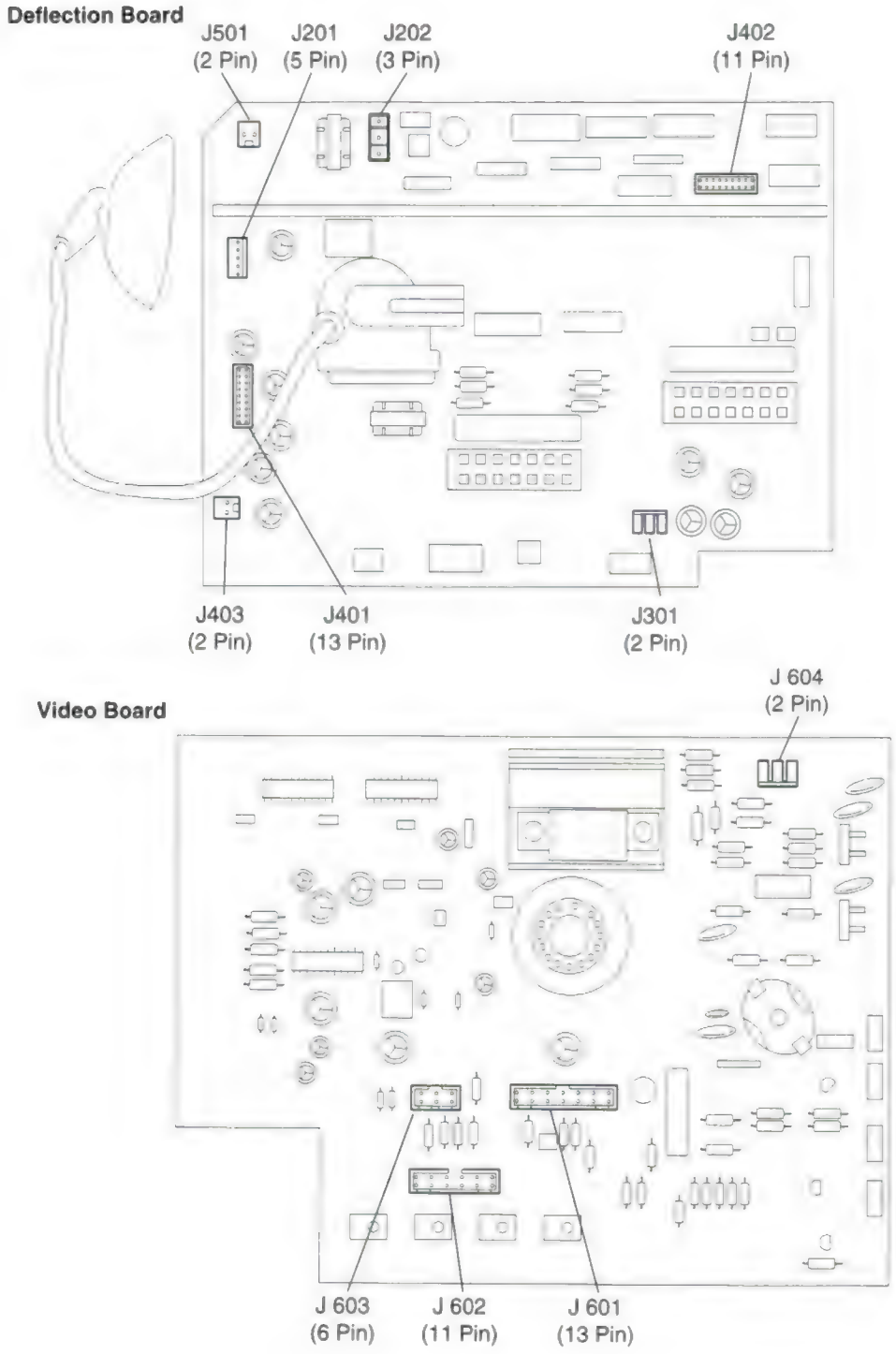


Figure 81. Apple Two-Page Monochrome Monitor Main Boards

Parts List

Bezel, Plastic Case	949-0223
Cable, Assembly, LED	590-0391
Cable, Flat, Main Board/Video Board, 12 Pin	590-0395
Cable, Flat, Main Board/Video Board, 14 Pin	590-0398
Cable, Main Board/Video Board, 3 Pin	590-0397
Cable, Power Supply, 6 Pin	590-0393
Cable, Power, 1.9M, U.S.	590-0371
Cable, Video, DB15 to DB25	590-0615
Cable, Video, DB25 to DB25	590-0574
Contrast Brightness Assembly	905-0007
CRT Assembly	076-0320
Deflection Board, Two-Page Monochrome Monitor	661-0451
Facilitation Warranty Reimbursement, Per Repair	011-0083
Fuse, 2.5 Amp, 250 V (Pkg. of 5)	941-0016
On Off Switch Filter Assembly	937-0040
Power Supply, Two-Page Monochrome Monitor	661-0453
Rear Cover, Plastic	949-0224
Screw/Knob Set	956-0012
Sub-Brightness, Focus, Horizontal Size, Vertical Size	011-0070
Tilt Swivel Monitor Stand	815-0558
Video Board, Two-Page Monochrome Monitor	661-0452

Symptom/Cure Chart

Use the following symptom/cure chart as a troubleshooting guide. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see Chapter 1, "General Monitor Information."

For additional assistance, contact Apple Technical Support.

No Raster	Solutions
No raster, LED off	1. Check AC power cord connections. 2. Check internal power connectors. 3. Replace blown fuse. 4. Replace power supply. 5. Replace on/off switch filter assembly. 6. Replace deflection board.
No raster, LED on	1. Adjust brightness and contrast knobs. 2. Verify that video card in computer is working properly. 3. Check power supply and deflection board connections. 4. Check CRT socket connectors. 5. Replace video board. 6. Replace deflection board. 7. Replace CRT and yoke assembly.

Geometry	Solutions
Raster size too short, tall, narrow, or wide	1. Adjust horizontal-size and vertical-size controls. 2. Replace deflection board. 3. Replace CRT and yoke assembly.
Raster not centered	1. Verify that distortion is not caused by environmental conditions. Move monitor to another location. 2. Adjust horizontal-shift and vertical-shift controls. 3. Replace video board.
Bad vertical linearity	1. Adjust vertical linearity control. 2. Replace deflection board.
Bad horizontal linearity	1. Adjust horizontal linearity control. 2. Replace deflection board.

Synchronization	Solutions
Single horizontal or vertical line appears on screen	1. Check yoke connectors. 2. Check CRT socket connectors. 3. Replace deflection board. 4. Replace CRT and yoke assembly.
Picture breaks into diagonal lines	1. Connect another monitor to computer. Switch on monitor to verify that computer produces video signal. 2. Check connections between video board and deflection board. 3. Replace deflection board. 4. Replace video board.
Picture rolls vertically	1. Verify that video card in computer is working properly. 2. Check connections between video board and deflection board. 3. Replace deflection board. 4. Replace video board.

Video	Solutions
Picture is too dark or too bright	1. Adjust contrast and brightness knobs. 2. Verify that video card in computer is working properly. 3. Check connection between contrast/brightness assembly and video board. 4. Perform video adjustments. 5. Replace video board. 6. Replace contrast/brightness assembly. 7. Replace CRT and yoke assembly.
Contrast/brightness unadjustable	1. Check connection between contrast/brightness assembly and video board. 2. Replace contrast/brightness assembly. 3. Replace video board. 4. Replace deflection board. 5. Replace CRT and yoke assembly.

Out of focus	1. Check CRT socket connectors. 2. Check connections between video board and deflection board. 3. Perform focus adjustment. 4. Check screen brightness with a light meter. If reading is "10" or higher, perform the Cutoff and Screen Luminance adjustments. 5. Replace video board. 6. Replace deflection board. 7. Replace CRT and yoke assembly.

Miscellaneous	**Solutions**
Picture jitters or flashes	1. Check all grounding cable connections. 2. Confirm that adjacent computer equipment is properly grounded. Move electrical devices away from the monitor and temporarily shut off all fluorescent lights. 3. Check connections between video board and deflection board. 4. Replace deflection board.
Black spots on screen (burnt phosphors)	Replace CRT.

Monitor Stand	**Solutions**
Monitor stand does not swivel	1. Verify that "Front" indicator on tilt/swivel mechanism aligns with "Front" indicator on base of monitor stand. 2. Verify that snap lock assembly on bottom of monitor stand is in place.
Monitor stand does not tilt	1. Verify that plastic plug is in snap lock assembly. 2. Verify that snap lock assembly on bottom of monitor stand is in place.

Adjustments

▲ Warning **This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review the CRT safety in rules Chapter 1, "General Monitor Information."**

Geometry

Geometry and video adjustments should always be performed whenever you replace the CRT, deflection board, or video board.

Note Reference the "Video Adjustments Foldout," Figure 82, when performing all Geometry and Video adjustments. Unfold Figure 82 so the graphic is visible while making adjustments.

Horizontal Linearity

1. Use Display Service Utility to display the Crosshatch II (white background) test pattern.

▲ Caution The linearity adjustment tool is the only tool that can be used to adjust the Horizontal Linearity control. Use of any other tool may damage the adjustment control coil core or cause a short in the monitor's circuitry.

2. Using the linearity adjustment tool, adjust the Horizontal Linearity control (see Figure 82A) until the raster is as wide as possible.
3. Using the linearity adjustment tool, slowly adjust the Horizontal Linearity control until the left and right halves of the raster are the same distance from the center of the screen.
   - To measure the left half of the raster, place a flexible ruler against the screen directly over the black horizontal line. Align the zero mark of the ruler with the left edge of the raster. Note the measurement at the point where the two black lines intersect.
   - To measure the right half of the raster, align the zero mark of the ruler where the two black lines intersect. Note the measurement at the right edge of the raster.
4. Using the plastic alignment tool, slowly adjust the Horizontal Size control (see Figure 82A) until the raster is 15 in. (± 1/8 in.) or 381 mm (± 3 mm) wide.
5. Verify that the left and right halves of the raster are still the same distance from the center of the screen. If necessary, adjust the Horizontal Linearity control.

6. Verify that the boxes on both the left and right sides of the screen are the same size as the boxes in the center of the screen. If they are not the same size, perform the next step.

▲ Warning **The monitor operates at extremely high voltages. To prevent electrical shock, use a plastic alignment tool to set the three-position switch (see Figure 82B). Avoid touching the heatsink or any other part of the monitor.**

If you do not use a plastic alignment tool, turn off the power before reaching inside the chassis and adjusting the switch. Then turn on the power and view the monitor screen.

7. Using the plastic alignment tool, set the three-position switch (see Figure 82B) to the lowest of the three settings and recheck the relative size of the boxes. Repeat for all three positions of the switch and select the best position.
8. Using the plastic alignment tool, slowly adjust the horizontal size control until the video image is 15 in. (± 1/8 in.) or 381 mm (± 3 mm) wide.
9. Verify that the raster is centered on the screen. If necessary, adjust the Horizontal Shift control (see Figure 82A).

Vertical Linearity

1. Use Display Service Utility to display the Crosshatch I or Crosshatch II test pattern.
2. Using the plastic alignment tool, adjust the orange capacitor at C306 (see Figure 82B) until the top two rows of boxes are the same height.
3. Using the plastic alignment tool, adjust the Vertical Linearity control (see Figure 82A) until the top and bottom rows of boxes are the same height.
4. Use Display Service Utility to display the All-White Screen test pattern.
5. Using the plastic alignment tool, adjust the Vertical Shift control (see Figure 82A) until the white raster is vertically centered.
6. Use Display Service Utility to display the All-White Screen test pattern.
7. Using a plastic alignment tool, adjust the Vertical Size control (see Figure 82A) until the white raster is 11 5/16 in. (± 1/8 in.) or 287.3 mm (± 3 mm) high.

Focus

1. Use Display Service Utility to display the Focus test pattern.
2. Using a plastic screwdriver, adjust the Static Focus control (see Figure 82B) for the best focus in the box at the center of the screen.
3. Using a plastic screwdriver, adjust the Horizontal Focus control (see Figure 82B) for the best focus in the box at the left and right sides of the screen.
4. Using a plastic screwdriver, adjust the Vertical Focus control (see Figure 82B) for the best focus in the box at the top and bottom center of the screen.
5. Repeat the adjustments until you have attained the best focus possible.

Video

▲ Warning **This product contains high voltage and a high-vacuum picture tube. To prevent serious injury, review the CRT safety in rules Chapter 1, "General Monitor Information."**

1. Switch off the power and remove the video cable from the back of the monitor.
2. Set the external (user) Contrast knob to maximum (turn fully clockwise) and the Brightness knob to the center (detent) position (see Figure 82A).
3. Using the plastic screwdriver, adjust the Cutoff control (see Figure 82B) to minimum (turn fully counterclockwise).
4. Switch on the power and wait 20 minutes for the monitor to warm up.
5. Use Display Service Utility to display the All-White Screen test pattern.

Note The Cutoff adjustment should be performed in a dimly lit room after the monitor has been on for at least 20 minutes.

6. Using the plastic screwdriver, turn the Cutoff control clockwise until a white raster just appears, then turn counterclockwise until the raster just fades to black.
7. Switch off the power and reconnect the video cable.
8. Switch on the power.

Note If the power is turned off for more than a few seconds, you must wait for another 20 minutes for the monitor to warm up.

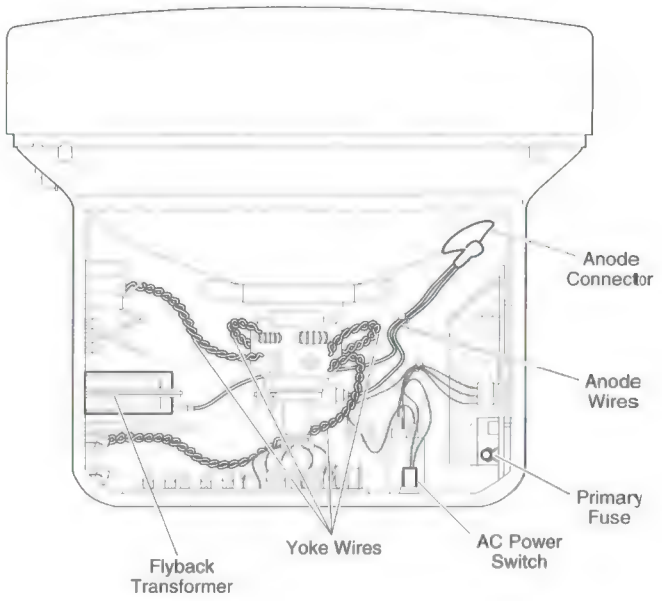
9. Use Display Service Utility to display the Gray Bars test pattern.
10. Using a plastic alignment tool, adjust the Cutoff control until the leftmost bar (darkest) is black and the next bar is barely distinguishable from the black bar.

Important Please note which meter you are using before making adjustments. Readings from light meter Model L–248 and Model 246 differ. (See the section, "Light Meter Setup," in Chapter 1, "General Monitor Information.")

11. Using Display Service Utility, display the All-White Screen test pattern.
12. Using a two-inch plastic screwdriver, adjust the sub-contrast control (see Figure 82A) until you get 31 foot lamberts (± 3 foot lamberts), which on the light meter is
    - Model L-248: middle of the 10 scale
    - Model 246: 23 on the red scale
13. Set the external (user) brightness knob to maximum (turn fully clockwise).
14. Using the plastic screwdriver, adjust the brightness range control (see Figure 82B) until you get 31 foot lamberts (± 3 foot lamberts), which on the light meter is
    - Model L-248: middle of the 10 scale
    - Model 246: 23 on the red scale
15. Reset the brightness knob to the center (detent) position.

Safety • WARNING •

Serious Injury could result if, with the power on, you touch any of the high-voltage area shown below. Review the CRT safety rules before performing adjustments.



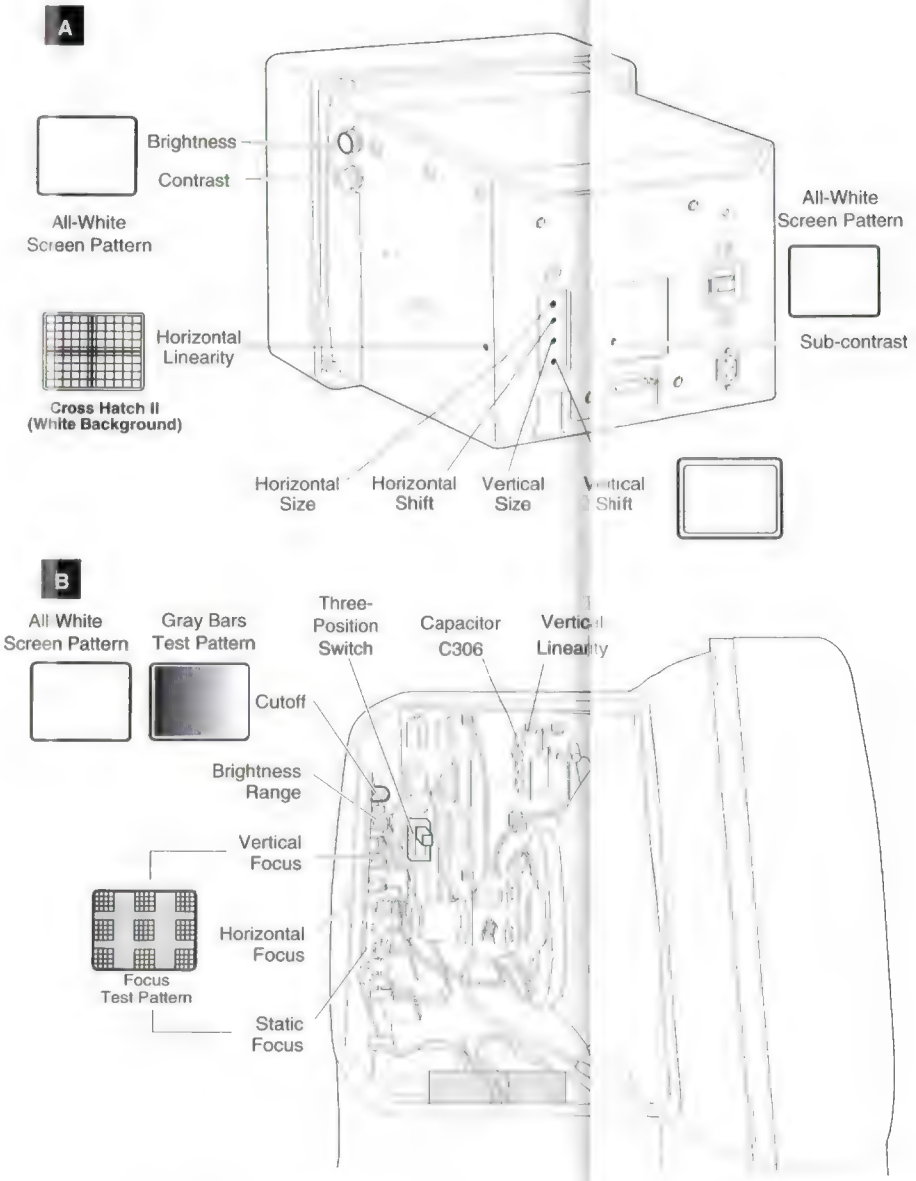
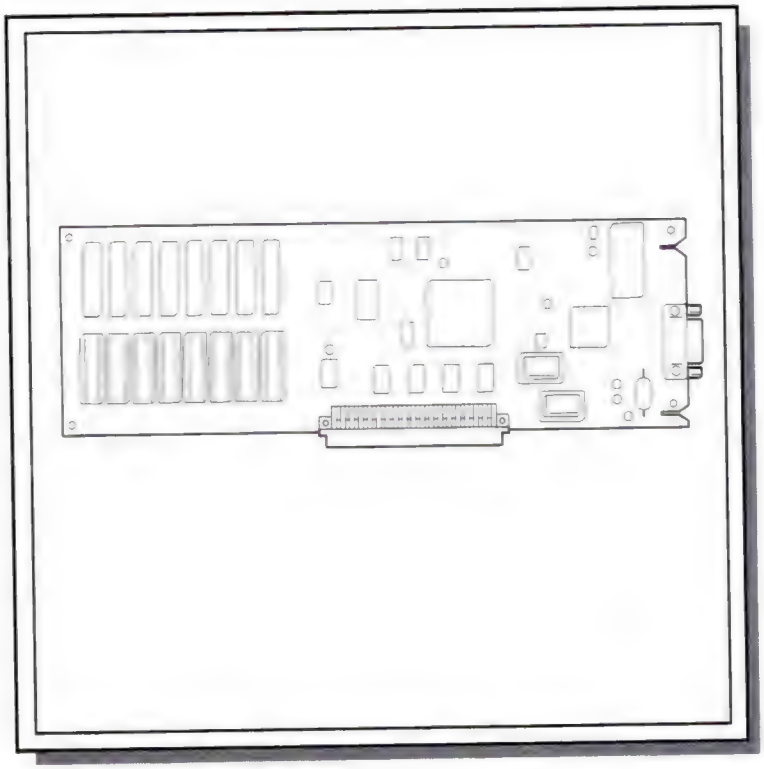


Figure 82. Apple Two-Page Monochrome Monitor—Safety and Video Adjustments

Macintosh Video Cards



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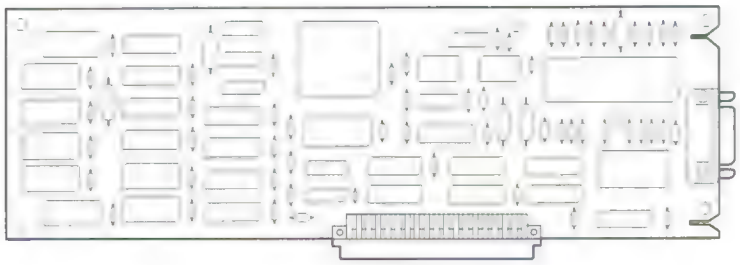
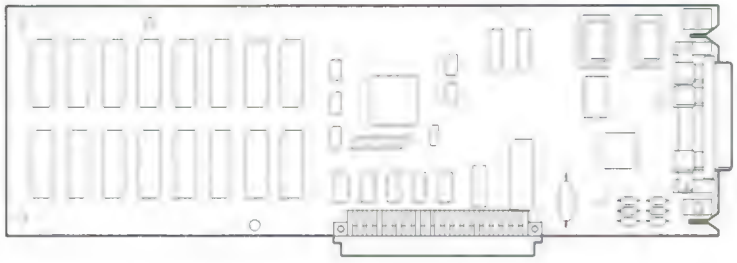
Macintosh Video Cards

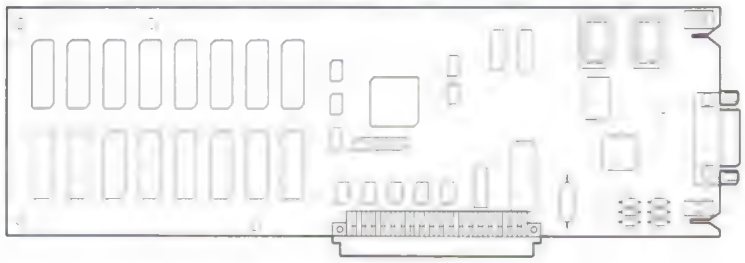
Macintosh II Video Card



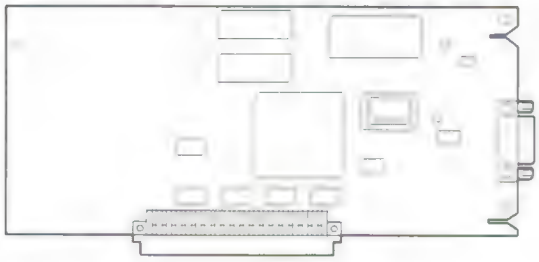
Macintosh II Two-Page Monochrome Video Card



Macintosh II Portrait Video Card



Macintosh II Monochrome Video Card, 1-Bit



Macintosh II High-Resolution Display Video Card

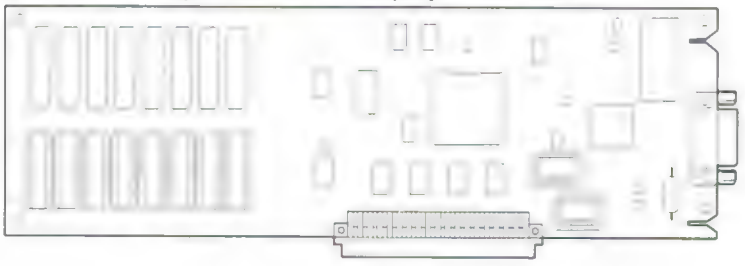
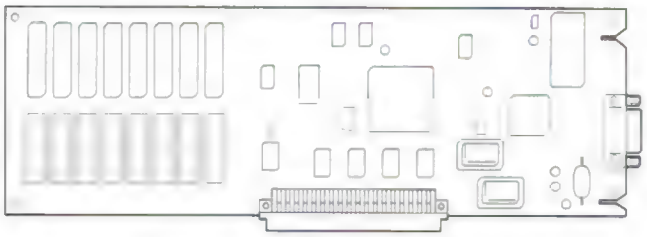
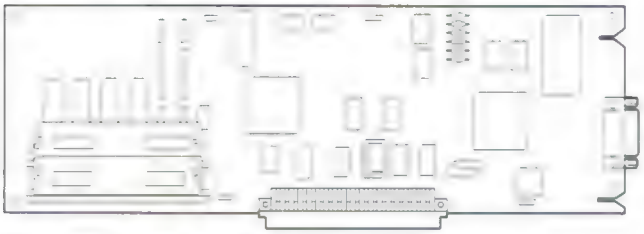


Figure 83. Macintosh Video Cards

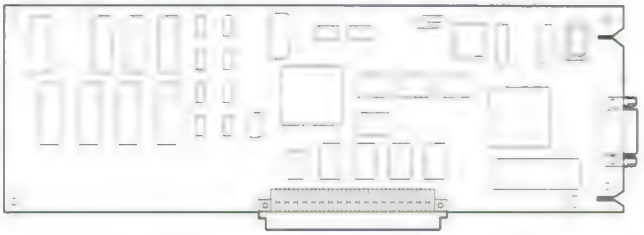
Macintosh II Extended High-Resolution Display Video Card



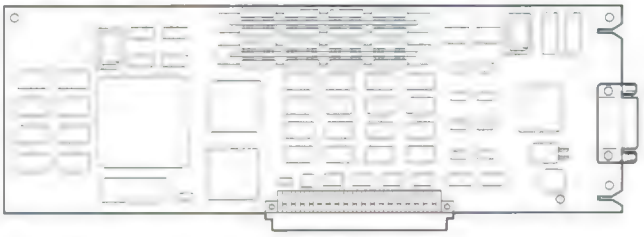
Macintosh Display Card 4/8



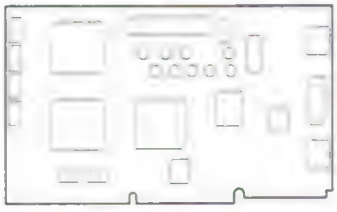
Macintosh Display Card 8/24



Macintosh Display Card 8/24 GC



PDS, Power Macintosh AV Card



Power Macintosh, 2 MB/ 4 MB Video Card
(The 2 and 4 MB Video Cards are similar in appearance.
See notes 5 and 6 on the Parts List.)

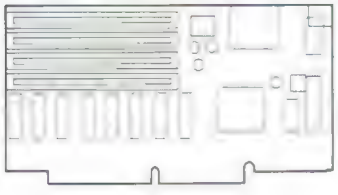


Figure 84. Macintosh Video Cards

Parts List

Apple Macintosh Display Card 24AC	661-0432
IC, Video Ram 150 ns	334-0024
Macintosh Display Card 4•8, Rev. B[1]	661-0677
Macintosh Display Card 4•8	661-0607
Macintosh Display Card 8•24 GC[2]	661-0606
Macintosh Display card 8•24, Rev. B[3]	661-0678
Macintosh Display Card 8•24[4]	661-0608
PDS, Power Macintosh AV Card	661-1023
Power Macintosh, 2 MB Video Card[5]	661-1748
Power Macintosh, 4 MB Video Card[6]	661-1027

1. This card (which replaces P/N 661-0607) can be upgraded to P/N 661-0678 (Display Card 8•24) by installing two VRAM SIMMS P/N 661-0609 (VRAM SIMM, 256K, 100 ns). Remove VRAM SIMMs before returning the display card to Apple for exchange.
   Compatibility: This card can be used in all Macintosh II and Quadra computers, and supports these monitors: Macintosh 12" Monochrome, Macintosh 12" RGB, AppleColor High-Resolution 13" RGB, Apple Macintosh Portrait Display, Macintosh 21" Color Display, Macintosh 16" Color Display, and the Apple Two-Page Monochrome Display.
2. Remove the two 1 MB video expansion SIMMs before returning the display card to Apple.
   Compatibility: This card is not compatible with the Macintosh IIsi, Quadra 700, or Quadra 900. The earlier 8•24 card can be ROM-upgraded to support the Macintosh 16" Color Display. The card will then provide 8-bit capability only.
3. This module replaces P/N 661-0608.
   Compatibility: This card can be used in all Macintosh II and Quadra computers, and supports these monitors: Macintosh 12" Monochrome, Macintosh 12" RGB, AppleColor High-Resolution 13" RGB, Apple Macintosh Portrait Display, Macintosh 21" Color Display, Macintosh 16" Color Display (requires Rev. B ROM card).
4. This module has been replaced by P/N 661-0678 and can be identified by the ROM part number ROM P/N 341-0868. Module 661-0608 can be upgraded to the newer card (661-0678) via a ROM upgrade under part number 076-0548. The ROM upgrade provides Page-White color correction for the Macintosh 21" Color Display.
   Compatibility: This card can be used in all Macintosh II and Quadra computers, and supports these monitors: Macintosh 12" Monochrome, Macintosh 12" RGB, AppleColor High-Resolution 13" RGB, Apple Macintosh Portrait Display, Macintosh 12" Color Display (supports white-point selection with Rev. B ROM), Apple Two-Page Monochrome Display, Macintosh 21" Color Display, Macintosh 16" Color Display (requires Rev. B ROM card).
5. This module is compatible with the Power Macintosh 7100/66 and 7100/80 computers. You can distinguish between the 2 MB and the 4 MB video cards by their part numbers and by the color of the silkscreening. The 2 MB card is silkscreened in yellow.
6. This module is compatible with the Power Macintosh 8100/80, 8100/100, and 8100/110 computers. You can distinguish between the 2 MB and the 4 MB video cards by their part numbers and by the color of the silkscreening. The 4 MB card is silkscreened in white.

ROM Upgrade for Display Card 4•8 (661-0607) or Display Card 8•24 (661-0608)	076-0548
ROM Upgrade for Display Card 8•24 GC (661-0606)	076-1019
Video Card, Apple Macintosh II Two-Page, Monochrome[7]	661-0456
Video Card, Mac II - 4 Bit,12B/W,13RGB[8]	661-0376
Video Card, Mac II Portrait Display DB15 & Video Cable	661-0587
Video Card, Mac II Portrait Display	661-0604
Video Card, Mac II, 8 BIT	661-0492
Video Card, Mac II, Extended Hi-Res Display (8-BIT)	661-0533
Video Card, Macintosh II Portrait Display, DB15	661-0586
Video Card, Macintosh II, Hi-Res Display (4-Bit)	661-0493
Video Card, Macintosh II, Monochrome - 1 BIT	661-0518
VRAM SIMM, 256K, 100ns	661-0609

7. Remove the eight video expansion RAM chips before returning the video card to Apple.
Compatibility: This card supports the following computers and monitors: Macintosh II, IIx, IIfx, Macintosh IIcx, IIci, Macintosh IIsi, and the Apple Two-Page Monochrome Monitor.

8. Remove the eight video expansion RAM chips before returning the video card to Apple.
Compatibility: This card supports the following computers and monitors: Macintosh II, IIx, IIfx, Macintosh IIcx, IIci, Apple High-Resolution Monochrome, and the AppleColor High-Resolution 13" RGB.

Troubleshooting

Symptom/Cure Chart

If a video card is not functioning correctly, a number of video symptoms may occur, such as a totally dark screen, or a bright screen with no recognizable video display. Use the following checklist as a general troubleshooting guide.

For additional assistance, contact Apple Technical Support.

Video	Solutions
Dark screen, bright screen without recognizable information; or other video problems	1. Reseat video card. 2. Reseat RAM or VRAM SIMM on video card. 3. Check cable connections. 4. Run video diagnostic tests. 5. Replace VRAM or DRAM (if socketed). 6. Replace video card.

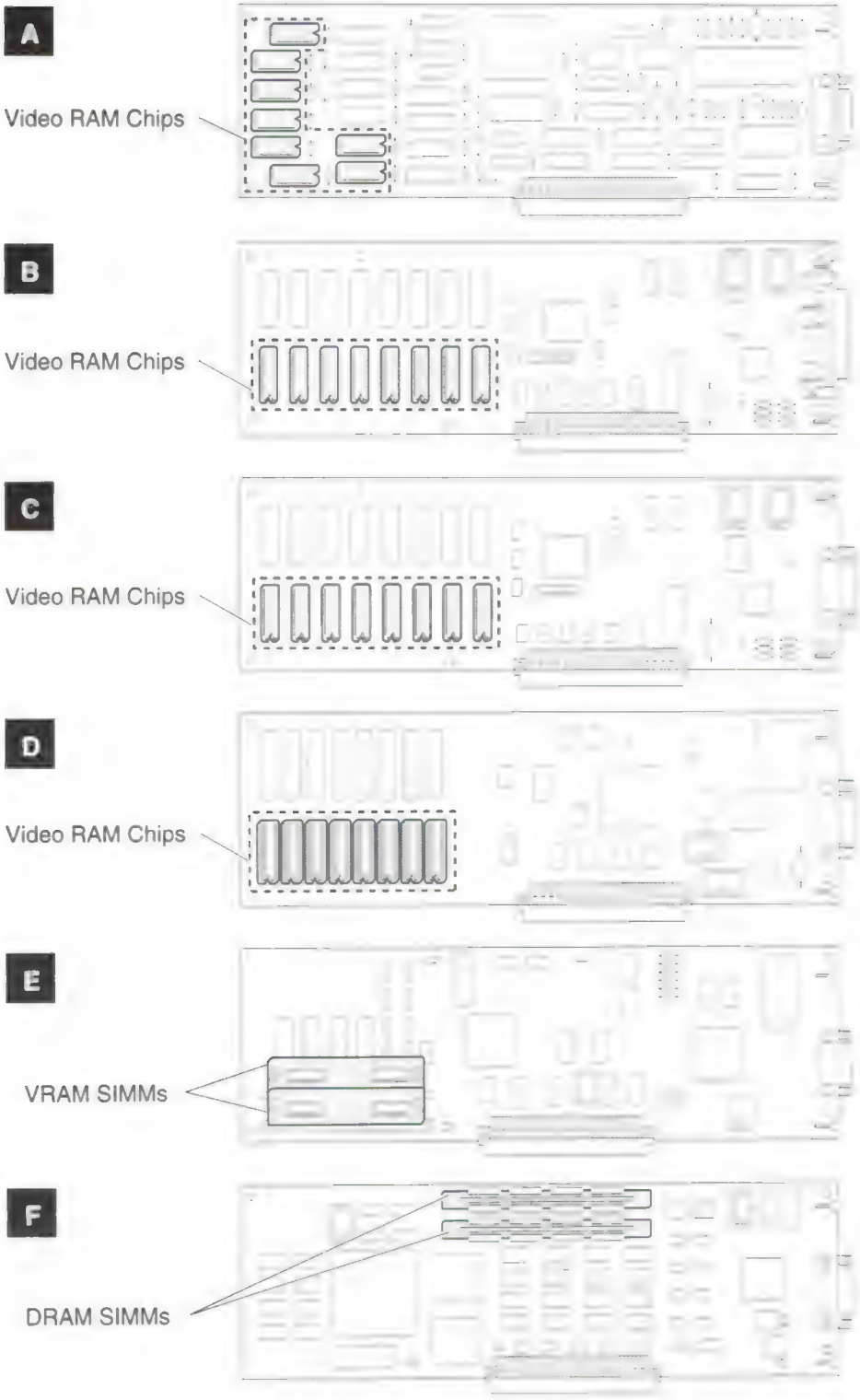


Figure 85. Macintosh II Video Card Upgrades

Macintosh II Video Card Upgrade

The Macintosh II Video Card upgrade (see Figure 85A) requires eight video RAM chips.

Note The required RAM chips are not available in an "upgrade kit." You must order the chips separately. The upgrade supports 8 bits per pixel and up to 256 colors or shades of gray.

1. Before you begin, remove the video card.
2. Install the eight video RAM chips in locations B1, C1, D1, E1, G1, H1, G2, and H2 on the video card (see Figure 85A). The notch at the end of each RAM chip should face the DB-15 connector on the rear of the card.

Two-Page Card Upgrade

The Two-Page Monochrome Video Card upgrade (see Figure 85B) requires eight video RAM chips.

Note The required RAM chips are not available in an "upgrade kit." You must order the chips separately. The upgrade supports 4 bits per pixel and up to 16 shades of gray.

1. Before you begin, remove the video card.
2. Install the eight video RAM chips in locations D1 through D8 on the video card (see Figure 85B). The notch at the end of each RAM chip should face the expansion slot connector on the bottom of the card.

Portrait Card Upgrade

The Portrait Video Card upgrade (see Figure 85C) requires eight video RAM chips.

Note The required RAM chips are not available in an "upgrade kit." You must order the chips separately. The upgrade supports 4 bits per pixel and up to 16 shades of gray.

1. Before you begin, remove the video card.
2. Install the eight video RAM chips in locations D1 through D8 on the video card (see Figure 85C). The notch at the end of each RAM chip should face the expansion slot connector on the bottom of the card.

Hi-Res Display Card Upgrade

The Hi-Resolution Display Video Card upgrade (see Figure 85D) requires eight video RAM chips.

Note The required RAM chips are not available in an "upgrade kit." You must order the chips separately. The upgrade supports 8 bits per pixel and up to 256 colors or shades of gray.

1. Before you begin, remove the video card.
2. Install the eight video RAM chips in locations C1 through C8 on the video card (see Figure 85D). The notch at the end of each RAM chip should face the expansion slot connector on the bottom of the card.

4•8 Card Upgrade

The Macintosh Display Card 4•8 upgrade (see Figure 85E) requires two VRAM SIMMs.

The upgrade supports

- 24-bit performance with 1 MB of video RAM (VRAM)
- 16.7 million true-color scale on the AppleColor High-Resolution RGB Monitor
- 256 gray levels on the Apple High-Resolution Monochrome Monitor, the Two-Page Monochrome Monitor, and the Macintosh Portrait Display

1. Before you begin, remove the video card.
2. Install the two VRAM SIMMs in the socket locations on the video card (see Figure 85E).

8•24GC Card Upgrade

The Macintosh Display Card 8•24GC upgrade (see Figure 85F) requires two DRAM SIMMs.

The upgraded card improves the performance of applications that use larger off-screen bitmaps and other imaging techniques.

1. Before you begin, remove the video card.
2. Install the two video DRAM SIMMs in the socket locations on the video card (see Figure 85F).

Macintosh LC Card Compatibility and Video Output Chart

Use these tables to determine the output expected from each configuration of built-in and NuBus video cards, monitors and computers.

Table 10. Macintosh LC Computers–Card Compatibility and Video Output Chart

Macintosh	Macintosh 12" Monochrome Display (M0298LL/A)	Macintosh 12" RGB Display (M0297LL/C)	Apple Basic Color Monitor–14" (M9108LL/B)	Apple Color Plus 14" Display (M2346LL/A)	Apple Performa Display–14" (M9101LL/D)	Apple Performa Display Plus–14" (M9102LL/D)	13/14/15/17/20" Displays, Multiple Scan 680 x 480[1]
LC/LC II							
256K VRAM	16 grays	256 colors	16 colors	16 colors	16 colors	16 colors	16 colors[2]
512K VRAM	256 grays	32,768 colors	256 colors	256 colors	256 colors	256 colors	256 colors[3]
LC III							
512K VRAM	256 grays	32,768 colors	256 colors	256 colors	256 colors	256 colors	256 colors
768K VRAM	256 grays	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors
LC 475							
512K VRAM	256 grays	32,768 colors	256 colors	256 colors	256 colors	256 colors	256 colors
1 MB VRAM	256 grays	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors
LC 630	256 grays	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors

1. Includes AppleColor High-Res RGB Monitor—13" (M0401LL/D), Macintosh Color Display—14" (M1198LL/B), Apple AudioVision 14 Display (B1247LL), Multiple Scan 14 (M3935LL), Multiple Scan 15 (M3089LL), Multiple Scan 17 (M2611LL), Multiple Scan 20 (M2612LL), AppleVision 1710AV Display (M3323LL), AppleVision 1710 (M3322LL), Multiple Scan 1705 (M4434LL).
2. Requires a display adapter with Multiple Scan 15 display.
3. Requires a display adapter with Multiple Scan 15 display.

Note: Macintosh LC 550 has a built-in Trinitron display with video output of 256 colors with 512K VRAM and 32,768 colors with 1 MB VRAM.

Note: Macintosh LC 575 has a built-in Trinitron display with video output of 32,768 colors.

Table 10. Macintosh LC Computers–Card Compatibility and Video Output Chart (Continued)

Macintosh	Macintosh 16" Color Display (M1044LL/A), Multiple Scan 15 (M3089LL), 17 (M32611LL), 20 (M2612LL) 832 x 624	Macintosh Portrait Display–15" (M0404)	Apple Two-Page Monochrome Monitor–21" (M0402)	Multiple Scan 17 (M2611LL) and 20 (M2612LL) 1024 x 768	Macintosh 21" Color Display (M5812LL/A), Multiple Scan 20 (M2612LL/A) 1152 x 870	AppleVision 1710 (M3322LL), 1710AV (M3323LL) 1280 x 1024
LC/LC II						
256K VRAM	N/A	N/A	N/A	N/A	N/A	N/A
512K VRAM	N/A	N/A	N/A	N/A	N/A	N/A
LC III						
512K VRAM	256 colors[1]	16 grays	N/A	N/A	N/A	N/A
768K VRAM	256 colors[2]	256 grays	N/A	N/A	N/A	N/A
LC 475						
512K VRAM	256 colors	16 grays	16 grays	16 grays	16 colors	N/A
1 MB VRAM	32,768 colors	256 grays	256 grays	256 grays	256 colors	N/A
LC 630	256 colors	N/A	N/A	N/A	N/A	N/A

1. Requires Display adapter to use Multiple Scan.
2. Requires Display adapter to use Multiple Scan.

Macintosh Performa Card Compatibility and Video Output Chart

Use these tables to determine the output expected from each configuration of built-in and NuBus video cards, monitors and computers.

Table 11. Macintosh Performa Computers–Card Compatibility and Video Output Chart

Macintosh	Macintosh 12" Monochrome Display (M0298LL/A)	Macintosh 12" RGB Display (M0297LL/C)	Apple Basic Color Monitor–14" (M9108LL/B)	Apple Color Plus 14" Display (M2346LL/A)	Apple Performa Display–14" (M9101LL/D)	Apple Performa Display Plus–14" (M9102LL/D)	13/14" Displays, Multiple Scan 680 x 480[1]
Performa 400, 405, 410, 430LC							
256K VRAM	16 grays	256 colors	16 colors	16 colors	16 colors	16 colors	16 colors[2]
512K VRAM	256 grays	32,768 colors	256 colors	256 colors	256 colors	256 colors	256 colors[3]
Performa 450							
512K VRAM	256 grays	32,768 colors	256 colors	256 colors	256 colors	256 colors	256 colors
768K VRAM	256 grays	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors
Performa 460, 466, 467							
512K VRAM	256 grays	32,768 colors	256 colors	256 colors	256 colors	256 colors	256 colors
768K VRAM	256 grays	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors
Performa 475, 476							
512K VRAM	256 grays	32,768 colors	256 colors	256 colors	256 colors	256 colors	256 colors
1 MB VRAM	256 grays	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors
Performa 600, 600CD							
512K VRAM	256 grays	32,768 colors	256 colors	256 colors	256 colors	256 colors	256 colors
1 MB VRAM	256 grays	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors
Performa 630	256 grays	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors
Performa 6200	256 grays	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors

1. Includes AppleColor High-Res RGB Monitor—13" (M0401LL/D), Macintosh Color Display—14" (M1198LL/B), Apple AudioVision 14 Display (B1247LL), Multiple Scan 14 (M3935LL), Multiple Scan 15 (M3089LL), Multiple Scan 17 (M2611LL), Multiple Scan 20 (M2612LL), AppleVision 1710AV Display (M3323LL), AppleVision 1710 (M3322LL), Multiple Scan 1705 (M4434LL).
2. Requires a display adapter with Multiple Scan 15 display.
3. Requires a display adapter with Multiple Scan 15 display.

Note: Macintosh Performa 550, 560, 5775, 577, 5778 computers have built-in Trinitron displays with video output of 32, 768 colors.
Note: MacintoshTV has a built-in Trinitron display with video output of 256 colors.

Table 11. Macintosh Performa Computers–Card Compatibility and Video Output Chart (Continued)

Macintosh	Macintosh 16" Color Display (M1044LL/A), Multiple Scan 15 (M3089LL), 17 (M32611LL), 20 (M2612LL) 832 x 624	Macintosh Portrait Display–15" (M0404)	Apple Two-Page Monochrome Monitor–21" (M0402)	Multiple Scan 17 (M2611LL) and 20 (M2612LL) 1024 x 768	Macintosh 21" Color Display (M5812LL/A), Multiple Scan 20 (M2612LL/A) 1152 x 870	AppleVision 1710 (M3322LL), 1710AV (M3323LL) 1280 x 1024
Performa 400, 405, 410, 430LC						
256K VRAM	N/A	N/A	N/A	N/A	N/A	N/A
512K VRAM	N/A	N/A	N/A	N/A	N/A	N/A
Performa 450						
512K VRAM	256 grays	16 grays	N/A	N/A	N/A	N/A
768K VRAM	256 grays	256 grays	N/A	N/A	N/A	N/A
Performa 460, 466, 467						
512K VRAM	256 colors[1]	16 grays	16 grays	16 grays	16 colors	N/A
768K VRAM	256 colors[2]	256 grays	256 grays	256 grays	256 colors	N/A
Performa 475, 476						
512K VRAM	256 colors	16 grays	16 grays	16 grays	16 grays	N/A
1 MB VRAM	32,768 colors	256 grays	256 grays	256 grays	256 grays	N/A
Performa 600, 600CD						
512K VRAM	N/A	N/A	N/A	N/A	N/A	N/A
1 MB VRAM	N/A	N/A	N/A	N/A	N/A	N/A
Performa 630[3]	256 colors	N/A	N/A	N/A	N/A	N/A
Performa 6200	256 colors	N/A	N/A	N/A	N/A	N/A

1. Requires display adapter to use Multiple Scan Displays at this resolution.
2. Requires display adapter to use Multiple Scan Displays at this resolution.
3. The Macintosh 630 family computers can use larger monitors such as the Multiple Scan 17 and 20. However, the maximum resolution on these monitors is 832 x 624, and, at this resoution, they cannot support the TV/video system.

Macintosh II Card Compatibility and Video Output Chart

Use these tables to determine the output expected from each configuration of built-in and NuBus video cards, monitors, and computers.

Table 12. Macintosh II Computers–Card Compatibility and Video Output Chart

Macintosh	Macintosh 12" Monochrome Display (M0298LL/A)	Macintosh 12" RGB Display (M0297LL/C)	Apple Basic Color Monitor–14" (M9108LL/B)	Apple Color Plus 14" Display (M2346LL/A)	Apple Performa Display–14" (M9101LL/D)	Apple Performa Display Plus–14" (M9102LL/D)	13/14/15/17/20" Displays, Multiple Scan 680 x 480[1]
IIsi, IIci	256 grays	256 colors	N/A	256 colors	256 colors	256 colors	256 colors[2]
IIvi, IIvx							
512K VRAM	256 grays	32,768 colors	256 colors	256 colors	256 colors	256 colors	256 colors[3]
1 MB VRAM	256 grays	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors[4]

1. Includes AppleColor High-Res RGB Monitor—13" (M0401LL/D), Macintosh Color Display—14" (M1198LL/B), Apple AudioVision 14 Display (B1247LL), Multiple Scan 14 (M3935LL), Multiple Scan 15 (M3089LL), Multiple Scan 17 (M2611LL), Multiple Scan 20 (M2612LL), AppleVision 1710AV Display (M3323LL), AppleVision 1710 (M3322LL), Multiple Scan 1705 (M4474LL).
2. The Multiple Scan 15 Display is not compatible with the Macintosh IIsi and IIci
3. Requires a display adapter with Multiple Scan 15 Display.
4. Requires a display adapter with Multiple Scan 15 Display.

Note: Macintosh II, IIx, IIcx, IIfx computers have no built-in video and require a video card.

Table 12. Macintosh II Computers–Card Compatibility and Video Output Chart (Continued)

Macintosh	Macintosh 16" Color Display (M1044LL/A), Multiple Scan 15 (M3089LL), 17 (M2611LL), 20 (M2612LL) 832 x 624	Macintosh Portrait Display–15 " (M0404)	Apple Two-Page Monochrome Monitor–21" (M0402)	Multiple Scan 17 (M2611LL) and 20 (M2612LL) 1024 x 768	Macintosh 21" Color Display (M5812LL/A), Multiple Scan 20 (M2612LL/A) 1152 x 870	AppleVision 1710 (M3322LL), 1710AV (M3323LL) 1280 x 1024
IIsi, IIci	N/A	16 grays	N/A	N/A	N/A	N/A
IIvi, IIvx						
512K VRAM	N/A	N/A	N/A	N/A	N/A	N/A
1 MB VRAM	N/A	N/A	N/A	N/A	N/A	N/A

Macintosh Centris/Quadra Card Compatibility and Video Output Chart

Use these tables to determine the output expected from each configuration of built-in and NuBus video cards, monitors, and computers.

Table 13. Macintosh Centris/Quadra Computers–Card Compatibility and Video Output Chart

Macintosh	Macintosh 12" Monochrome Display (M0298LL/A)	Macintosh 12" RGB Display (M0297LL/C)	Apple Basic Color Monitor – 14" (M9108LL/B)	Apple Color Plus 14" Display (M2346LL/A)	Apple Performa Display – 14" (M9101LL/D)	Apple Performa Display Plus – 14" (M9102LL/D)	13/14/17/20" Displays, Multiple Scan 680 x 480[1]
Quadra 605							
512K VRAM	256 grays	32,768 colors	256 grays	256 colors	256 colors	256 colors	256 colors
1 MB VRAM	256 grays	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors
Centris/Quadra 610, 650							
512K VRAM	256 grays	32,768 colors	256 colors	256 colors	256 colors	256 colors	256 colors
1 MB VRAM	256 grays	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors
Quadra 660AV							
1 MB VRAM	256 grays	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors
Quadra 630	256 grays	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors
Quadra 700							
512K VRAM	256 grays	256 colors	256 colors	256 colors	256 colors	256 colors	256 colors
1 MB VRAM	256 grays	16.7 million colors	256 colors	256 colors	256 colors	256 colors	256 colors
2 MB VRAM	256 grays	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors
Quadra 800							
512K VRAM	256 grays	32,768 colors	256 colors	256 colors	256 colors	256 colors	256 colors
1 MB VRAM	256 grays	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors
Quadra 840AV							
1 MB VRAM	256 grays	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors
2 MB VRAM	256 grays	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors
Quadra900							
1 MB VRAM	256 grays	16.7 million colors	256 colors	256 colors	256 colors	256 colors	256 colors
2 MB VRAM	256 grays	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors
Quadra 950							
1 MB VRAM	256 grays	32,768 colors	32,768 colors	32,768 colors	256 colors	256 colors	256 colors
2 MB VRAM	256 grays	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors

1. Includes AppleColor High-Res RGB Monitor—13" (M0401LL/D), Macintosh Color Display—14" (M1198LL/B), Apple AudioVision 14 Display (B1247LL), Multiple Scan 14 (M3935LL), Multiple Scan 15 (M3089LL), Multiple Scan 17 (M2611LL), Multiple Scan 20 (M2612LL), AppleVision 1710AV Display (M3323LL), AppleVision 1710 (M3322LL), Multiple Scan 1705 (M4434LL).

Table 13. Macintosh Centris/Quadra Computers–Card Compatibility and Video Output Chart (Continued)

Macintosh	Macintosh 16" Color Display, Multiple Scan 15, 17, 20 832 x 624[1]	Macintosh Portrait Display – 15" (M0404)	Apple Two-Page Monochrome Monitor – 21" (M0402)	Multiple Scan 17 (M211LL) and 20 (M2612LL) 1024 x 768[2]	Macintosh 21" Color Display (M5812LL/A), Multiple Scan 20 (M2612LL/A) 1152 x 870[3]	AppleVision 1710 (M3322LL), 1710AV (M3323LL) 1280 x 1024[4]
Quadra 605						
512K VRAM	256 colors	16 grays	16 grays	16 grays	16 grays	N/A
1 MB VRAM	32,768 colors	256 grays	256 grays	256 gray	256 grays	N/A
Centris/Quadra 610, 650						
512K VRAM	256 colors	16 grays	16 grays	16 colors	16 colors	N/A
1 MB VRAM	32,768 colors	256 grays	256 grays	256 colors	256 colors	N/A
Centris/Quadra 660AV						
1 MB VRAM	32,768 colors	256 grays	256 grays	256 colors	256 colors	N/A
Quadra 630[5]	256 colors	N/A	N/A	N/A	N/A	N/A
Quadra 700						
512K VRAM	256 colors	16 grays	16 grays	N/A	16 colors	N/A
1 MB VRAM	256 colors	256 grays	256 grays	N/A	256 colors	N/A
2 MB VRAM	16.7 million colors	256 grays	256 grays	N/A	256 colors	N/A
Quadra 800						
512K VRAM	256 colors	16 grays	16 grays	16 colors	16 colors	N/A
1 MB VRAM	256 colors	256 grays	256 grays	256 colors	256 colors	N/A
Quadra 840AV						
1 MB VRAM	32,768 colors	256 grays	256 grays	256 colors	256 colors	N/A
2 MB VRAM	16.7 million colors	256 grays	256 grays	32,768 colors	32,768 colors	N/A
Quadra900						
1 MB VRAM	256 colors	256 grays	256 grays	N/A	256 colors	N/A
2 MB VRAM	16.7 million colors	256 grays	256 grays	N/A	256 colors	N/A
Quadra 950						
1 MB VRAM	256 colors	256 grays	256 grays	256 colors	256 colors	N/A
2 MB VRAM	16.7 million colors	256 grays	256 grays	256 colors	32,768 colors	N/A

1. Macintosh 16" Color Display (M1044LL/A), Multiple Scan 15 (M3089LL), Multiple Scan 17 (M2611LL), Multiple Scan 20 (M2612LL).
2. Multiple Scan 17 (M2611LL), Multiple Scan 20 (M2612LL).
3. Macintosh 21" Color Display (M5812LL/A), Multiple Scan 20 Display (M2612LL/A, M2612LL/B).
4. AppleVision 1710AV Display (M3323LL). AppleVision 1710 Display (M3322LL).
5. The Macintosh 630 family computers can use larger monitors such as the Multiple Scan 17 and 20. However the maximum resolution is 832 x 624, and at this resolution they cannot support TV/video).

Power Macintosh Card Compatibility and Video Output Chart

Use these tables to determin the output from each configuration of built-in and NuBus video cards, monitors, and computers.

Table 14. Power Macintosh Computers–Card Compatibility and Video Output Chart

Macintosh	Macintosh 12" Monochrome Display (M0298LL/A)	Macintosh 12" RGB Display (M0297LL/C)	Apple Basic Color Monitor – 14" (M9108LL/B)	Apple Color Plus 14" Display (M2346LL/A)	Apple Performa Display – 14" (M9101LL/D)	Apple Performa Display Plus – 14" (M9102LL/D)	13/14/17/20" Displays, Multiple Scan 680 x 480[1]
6100							
HDI-45 [2]	256 grays	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors
6100AV							
2 MB VRAM	256 grays	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors
7100							
HDI-45 [3]	256 grays	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors
1 MB VRAM	256 grays	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors
2 MB VRAM	256 grays	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors
7100AV							
2 MB VRAM	256 grays	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors
7200							
1 MB VRAM	32,768 colors	16.7 million colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors
2 MB VRAM	16.7 million clrs.	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors
4 MB VRAM	16.7 million clrs.	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors
7500							
2 MB VRAM	256 grays	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors
4 MB VRAM	256 grays	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors
8100							
HDI-45 [4]	256 grays	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors
2 MB VRAM	256 grays	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors
4 MB VRAM	256 grays	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors
8100AV	256 grays	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors
8500							
2 MB VRAM	256 grays	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors
4 MB VRAM	256 grays	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors
9500/120							
2 MB VRAM	256 grays	N/A[5]	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors
4 MB VRAM	256 grays	N/A[6]	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors

1. Includes AppleColor High-Res RGB Monitor—13" (M0401LL/D), Macintosh Color Display—14" (M1198LL/B), Apple AudioVision 14 Display (B1247LL), Multiple Scan 14 (M3935LL), Multiple Scan 15 (M3089LL), Multiple Scan 17 (M2611LL), Multiple Scan 20 (M2612LL), AppleVision 1710AV Display (M3323LL), AppleVision 1710 (M3322LL), Multiple Scan 1705 (M4434LL).
2. HDI-45 port makes use of 640K of internal DRAM memory.
3. HDI-45 port makes use of 640K of internal DRAM memory.
4. HDI-45 port makes use of 640K of internal DRAM memory.
5. The Macintosh 12-inch RGB display cannot be used with Power Macintosh 9500 series.
6. The Macintosh 12-inch RGB display cannot be used with Power Macintosh 9500 series.

Table 14. Power Macintosh Computers–Card Compatibility and Video Output Chart (Continued)

Macintosh	Macintosh 16" Color Display (M1044LL/A), Multiple Scan 15 (M3089LL), 17 (M2611LL), 20 (M2612LL) 832 x 624	Macintosh Portrait Display – 15" (M0404)	Apple Two-Page Monochrome Monitor–21" (M0402)	Multiple Scan 17 (M2611LL) and 20 (M2612LL) 1024 x 768	Macintosh 21" Color Display (M5812LL/A), Multiple Scan 20 (M2612LL/A) and M2612LL/B) 1152 x 870	AppleVision 1710 (M3322LL), 1710AV (M3323LL) 1280 x 1024
6100						
HDI-45 [1]	256 colors	256 grays	N/A	N/A	N/A	N/A
6100AV						
2 MB VRAM	16.7 million colors	256 grays	256 grays	32,768 colors	32,768 colors	N/A
7100						
HDI-45 [2]	256 colors	256 grays	N/A	N/A	N/A	N/A
1 MB VRAM	32,768 colors	256 grays	256 grays	256 colors	256 colors	N/A
2 MB VRAM	16.7 million colors	256 grays	256 grays	32,768 colors	32,768 colors	N/A
7100AV						
2 MB VRAM	16.7 million colors	256 grays	256 grays	32,768 colors	32,768 colors	N/A
7200						
1 MB VRAM	32,768 colors	256 grays	256 grays	256 colors	256 colors	N/A
2 MB VRAM	16.7 million colors	256 grays	256 grays	32,768 colors	32,768 colors	N/A
4 MB VRAM	16.7 million colors	256 grays	256 grays	16.7 million colors	32,768 colors	N/A
7500						
2 MB VRAM	16.7 million colors	256 grays	256 grays	32,768 colors	32,768 colors	N/A
4 MB VRAM	16.7 million colors	256 grays	256 grays	16.7 million colors	16.7 million colors	N/A
8100						
HDI-45 [3]	256 colors	256 grays	N/A	N/A	N/A	N/A
2 MB VRAM	16.7 million colors	256 grays	256 grays	32,768 colors	32,768 colors	N/A
4 MB VRAM	16.7 million colors	256 grays	256 grays	16.7 million colors	16.7 million colors	N/A
8100AV						
	16.7 million colors	256 grays	256 grays	32,768 colors	32,768 colors	N/A
8500						
2 MB VRAM	16.7 million colors	256 grays	256 grays	32,768 colors	32,768 colors	N/A
4 MB VRAM	16.7 million colors	256 grays	256 grays	16.7 million colors	32,768 colors	N/A
9500/120						
2 MB VRAM	16.7 million colors	256 grays	256 grays	32,768 colors	32,768 colors	N/A
4 MB VRAM	16.7 million colors	256 grays	256 grays	16.7 million colors	16.7 million colors	N/A

1. HDI-45 port makes use of 640K of internal DRAM memory.
2. HDI-45 port makes use of 640K of internal DRAM memory.
3. HDI-45 port makes use of 640K of internal DRAM memory.

Macintosh PowerBook Computers Card Compatibility and Video Output Chart

Use these tables to determine the output expected from each configuration of built-in and NuBus video cards, monitors, and computers.

Table 15. Macintosh PowerBook Computers–Card Compatibility and Video Output Chart

Macintosh	Macintosh 12" Monochrome Display (M0298LL/A)	Macintosh 12" RGB Display (M0297LL/C)	Apple Basic Color Monitor – 14" (M9108LL/B)	Apple Color Plus 14" Display (M2346LL/A)	Apple Performa Display – 14" (M9101LL/D)	Apple Performa Display Plus – 14" (M9102LL/D)	13/14/15/17/20" Displays, Multiple Scan 640 x 480[1]
PowerBook 160, 165, 165c,180, 180c	256 grays	256 colors	256 colors	256 colors	256 colors	256 colors	256 colors
PowerBook 500 series	256 grays	256 colors	256 colors	256 colors	256 colors	256 colors	256 colors
PowerBook 5300 series	N/A	N/A	N/A	N/A	256 colors	256 colors	256 colors
PowerBook 190 series	N/A	N/A	N/A	N/A	256 colors	256 colors	256 colors
PowerBook Duo Dock 512K VRAM 1 MB VRAM	 256 grays 256 grays	 256 colors 32,768 colors	 256 colors 32,768 colors	 256 colors 32,768 colors	 256 colors 32,768 colors	 256 colors 32,768 colors	 256 colors[2] 32,768 colors[3]
PowerBook MiniDock 512K VRAM	 256 grays	 256 colors	 256 colors	 256 colors	 256 colors	 256 colors	 256 colors
PowerBook Duo Dock II	256 grays	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors	32,768 colors

1. Includes AppleColor High-Res RGB Monitor—13" (M0401LL/D), Macintosh Color Display—14" (M1198LL/B), Apple AudioVision 14 Display (B1247LL), Multiple Scan 14 (M3935LL), Multiple Scan 15 (M3089LL), Multiple Scan 17 (M2611LL), Multiple Scan 20 (M2612LL), AppleVision 1710AV Display (M3323LL), AppleVision 1710 (M3322LL), Multiple Scan 1705 (M4434LL).
2. Requires display adapter to display additional resolutions, unless System 7.5 is installed.
3. Requires display adapter to display additional resolutions, unless System 7.5 is installed.

Table 15. Macintosh PowerBook Computers–Card Compatibility and Video Output Chart (Continued)

Macintosh	Macintosh 16" Color Display (M1044LL/A), Multiple Scan 15 (M3089LL), 17 (M2611LL), 20 (M2612LL) 832 x 624	Macintosh Portrait Display–15" (M0404)	Apple Two-Page Monochrome Monitor–21" (M0402)	Multiple Scan 17 (M2611LL) and 20 (M2612LL) 1024 x 768	Macintosh 21" Color Display (M5812LL/A), Multiple Scan 20 (M2612LL/A) 1152 x 870	AppleVision 1710 (M3322LL), 1710AV (M3323LL) 1280 x 1024
PowerBook 160, 165, 165c, 180, 180c	256 colors[1]	256 grays	N/A	N/A	N/A	N/A
PowerBook 500 series	256 colors	256 grays	N/A	N/A	N/A	N/A
PowerBook 5300 series	256 colors	256 grays	N/A	N/A	N/A	N/A
PowerBook 190 series	256 colors	256 grays	N/A	N/A	N/A	N/A
PowerBook Duo Dock 512K VRAM 1 MB VRAM	256 colors 32,768 colors[2]	256 grays 256 grays	N/A N/A	N/A N/A	N/A N/A	N/A N/A
PowerBook MiniDock 512K VRAM	256 colors	256 grays	N/A	N/A	N/A	N/A
PowerBook Duo Dock II	32,768 colors	256 grays	256 grays	256 colors	256 colors	N/A

1. Requires display adapter to use Multiple Scan Displays at this resolution.
2. The Duo Dock requires a video adapter to change resolutions unless System 7.5 is installed.

Video Cards Compatibility and Video Output Chart

Use the following table to determine which cards are compatible with which monitors and to determine the output that you can obtain with each configuration.

Table 16. Video Cards–Card Compatibility and Video Output Chart

Display Card	Macintosh 12" Monochrome Display (M0298LL/A)	Macintosh 12" RGB Display (M0297LL/C)	Apple Basic Color Monitor–14" (M9108LL/B)	Apple Color Plus 14" Display (M2346LL/A)	Apple Performa Display–14" (M9101LL/D)	Apple Performa Display Plus–14" (M9102LL/D)	13/14/15/17/20" Displays, Multiple Scan 640 x 480[1]
Macintosh II	256 grays	N/A	N/A	16 colors	N/A	N/A	N/A
Two-Page Mono	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Portrait	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Mono	2 grays	N/A	N/A	N/A	N/A	N/A	N/A
High-Res[2]	16 grays	N/A	16 colors	16 colors	16 colors	16 colors	16 colors
Ext High-Res	256 grays	N/A	N/A	256 colors	256 colors	256 colors	256 colors[3]
4•8[4]	256 grays	N/A	256 colors	256 colors	256 colors	256 colors	256 colors[5]
8•24	256 grays	16.7 million colors	N/A	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors
8•24GC	256 grays	16.7 million colors	N/A	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors
Display Card 24 AC	256 grays	16.7 million colors	N/A	16.7 million colors	16.7 million colors	16.7 million colors	16.7 million colors

1. Includes AppleColor High-Res RGB Monitor—13" (M0401LL/D), Macintosh Color Display—14" (M1198LL/B), Apple AudioVision 14 Display (B1247LL), Multiple Scan 14 (M3935LL), Multiple Scan 15 (M3089LL), Multiple Scan 17 (M2611LL), Multiple Scan 20 (M2612LL), AppleVision 1710AV Display (M3323LL), AppleVision 1710 (M3322LL), Multiple Scan 1705 (M4434LL).
2. The High-Res card can be upgraded with eight Macintosh II Video Expansion RAM chips.
3. Requires display adapter to display additional resolutions, unless System 7.5 is installed.
4. The 4•8 card can be upgraded to 8•24 by adding two VRAM SIMMs.
5. Requires display adapter to display additional resolutions, unless System 7.5 is installed.

Table 16. Video Cards–Card Compatibility and Video Output Chart (Continued)						
Display Card	**Macintosh 16" Color Display, Multiple Scan 15, 17, 20** **832 x 624**[1]	**Macintosh Portrait Display – 15"** **(M0404)**	**Apple Two-Page Monochrome Monitor – 21"** **(M0402)**	**Multiple Scan 17 (M2611LL) and 20 (M2612LL)** **1024 x 768**	**Macintosh 21" Color Display (M5812LL/A), Multiple Scan 20 (M2612LL/A)** **1152 x 870**[2]	**AppleVision 1710 (M3322LL), 1710AV (M3323LL),** **1280 x 1024**[3]
Macintosh II	N/A	N/A	N/A	N/A	N/A	N/A
Two-Page Mono	N/A	N/A	4 grays	N/A	N/A	N/A
Portrait	N/A	4 grays	N/A	N/A	N/A	N/A
Mono	N/A	N/A	N/A	N/A	N/A	N/A
High-Res[4]	N/A	N/A	N/A	N/A	N/A	N/A
Ext High-Res	N/A	N/A	N/A	N/A	N/A	N/A
4•8[5]	256 colors[6 7]	16 grays	16 grays	N/A	16 colors[8]	N/A
8•24	256 colors[9 10]	256 grays	256 grays	N/A	256 colors[11]	N/A
8•24GC	32,768 colors[12 13]	256 grays	256 grays	N/A	256 colors[14]	N/A
Display Card 24 AC	16.7 million colors	256 grays	256 grays	16.7 million colors	16.7 million colors	N/A

1. Macintosh 16" Color Display (M1044LL/A), Multiple Scan 15 (M3089LL), Multiple Scan 17 (M2611LL), Multiple Scan 20 (M2612LL).
2. Macintosh 21" Color Display (M5812LL/A), Multiple Scan 20 Display (M2612LL/A, M2612LL/B).
3. AppleVision 1710AV Display (M3323LL), AppleVision 1710 Display (M3322LL).
4. Can be upgraded with eight Macintosh II Video Expansion RAM chips (Service P/N 334-002) for 256 grays/colors.
5. The 4•8 can be upgraded to 8•24 by adding two VRAM SIMMs (Service P/N 661-0609).
6. Requires display adapter to use Multiple Scan Displays at this resolution.
7. Available with Rev. B ROM.
8. Requires display adapter to use Multiple Scan Displays at this resolution.
9. Requires display adapter to use Multiple Scan Displays at this resolution.
10. Available with Rev. B card.
11. Requires display adapter to use Multiple Scan Displays at this resolution.
12. Requires display adapter to use Multiple Scan Displays at this resolution.
13. Available with Rev. B card.
14. Requires display adapter to use Multiple Scan Displays at this resolution.

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